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Oil Theft and Revenue Loss in Nigeria

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Abstract: This paper investigates the effects of oil theft on revenue loss in Nigeria over the period 1990 to 2025. Crude Oil Theft, Pipeline Vandalisation, Crude Oil Production, Security Expenditure on Oil Production were used as a proxy for oil theft while revenue loss serves as the dependent variable. Secondary data were sourced from the World Bank World Development indicators (WDI), International, Monetary Fund (IMF) and United Nations Conference on Trade and Development (UNCTAD) Report 2025. 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 crude oil theft had a negative but significant relationship with revenue. However, pipeline vandalisation exhibited a positive and significant relationship with revenue loss. Also, crude oil production reported a negative and insignificant relationship with revenue loss while security expenditure on oil production had a positive but insignificant relationship with revenue loss. Hence, it was concluded that oil theft had a significant impact on revenue loss in Nigeria. It was recomemded amongst that the Federal Government of Nigeria, through the Nigerian National Petroleum Company Limited and the Nigerian Upstream Petroleum Regulatory Commission, should intensify the deployment of advanced surveillance technologies such as real-time metering systems, drones, and satellite monitoring to curb crude oil theft.

Keywords: Crude Oil Theft, Pipeline Vandalisation, Crude Oil Production, Security Expenditure on Oil Production Revenue Loss.

Research Paper

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INTRODUCTION

Oil theft has become a critical challenge in resource-rich economies, particularly in oil-dependent countries where petroleum revenues constitute a major source of government income. The persistent diversion of crude oil through illegal means has increasingly undermined fiscal stability, weakened institutional capacity, and constrained economic development. In contemporary literature, oil theft is often referred to as illegal bunkering or as the unauthorized extraction, diversion, and commercialization of crude oil from pipelines, wellheads, and export terminals. According to Katsouris and Sayne (2013) oil theft is a highly organized transnational criminal enterprise, while Dimkpa *et al.,* (2023), emphasize its systemic nature, linking it to governance failures, regulatory inefficiencies, and socio-economic vulnerabilities within oil-producing regions. The economic implications of oil theft are profound, particularly in terms of revenue loss. Directly, it reduces the volume of crude oil available for export, thereby diminishing government earnings and foreign exchange inflows. Indirectly, it escalates operational and security costs, disrupts production activities, and discourages both domestic and foreign investment in the petroleum sector. These combined effects weaken fiscal capacity, exacerbate budgetary deficits, and heighten macroeconomic instability, especially in economies that are heavily reliant on oil revenues.

In Nigeria, the challenge of oil theft has reached alarming proportions, posing a significant threat to national revenue generation and economic sustainability. As a country where crude oil accounts for a substantial share of government revenue, the continuous loss of oil resources has severe fiscal implications. Take for instance, the Nigeria Extractive Industries Transparency Initiative (NEITI) reported that approximately 7.68 million barrels of crude oil were lost in 2023 alone (NEITI, 2024), while losses were estimated at 37.6 million barrels in 2021 (NUPRC, 2025). Over a broader

period, Nigeria lost over 701 million barrels of crude oil between 1999 and 2023 (NEITI, 2025), alongside 362.28 million barrels between 2014 and 2023 (NEITI, 2024). These losses translate into billions of dollars in foregone revenue, thereby constraining the government's ability to finance critical sectors and undermining overall economic performance.

Despite numerous policy interventions and the growing body of empirical literature, oil theft remains pervasive in Nigeria, suggesting that existing strategies have yielded limited success. More importantly, extant studies have largely been descriptive or restricted in scope, with insufficient emphasis on rigorous econometric analysis that captures the dynamic relationship between oil theft and revenue loss over time. Additionally, there is a noticeable gap in the integration of recent data and evolving trends in oil theft into empirical investigations. This limitation constrains the depth of policy-relevant insights and weakens the evidence base required for effective decision-making. Against this backdrop, the persistent scale of oil theft, its significant impact on revenue loss, and the limitations of existing empirical studies underscore the need for a more comprehensive and methodologically robust investigation. This study, therefore, seeks to bridge this gap by providing an in-depth econometric analysis of the relationship between oil theft and revenue loss in Nigeria, with a view to generating evidence-based insights for policy formulation and sustainable economic management. 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

Oil Theft

Oil theft has been widely conceptualized in the literature as a multifaceted economic and criminal phenomenon According to Katsouris and Sayne (2013 oil theft as a highly organized and transnational criminal enterprise involving the illegal extraction and export of crude oil through networks that span local communities, security actors, and international buyers. The authors argue that oil theft in Nigeria is not merely opportunistic vandalism but a structured economic crime sustained by weak governance, institutional failure, and complicity across different levels of the oil value chain. This definition emphasizes the sophistication and global connectivity of oil theft operations, showing that it extends beyond local illegal activities to internationally coordinated illicit trade. Odalonu (2015) sees oil theft as the illegal tapping, diversion, and siphoning of crude oil from pipelines and other petroleum infrastructure for private economic gain. The study attributes the persistence of oil theft to socio-economic factors such as unemployment, poverty, and weak regulatory enforcement in oil-producing communities. This perspective highlights the localized and incentive-driven nature of oil theft, where economic deprivation and institutional weaknesses create an enabling environment for illegal oil-related activities.

Accordingly, Dimkpa *et al*., (2023) describe oil theft as the unauthorized appropriation of petroleum resources through pipeline vandalism, illegal refining, and crude oil bunkering activities that generate substantial revenue losses for the Nigerian economy. Their analysis situates oil theft within the broader context of fiscal instability, demonstrating its measurable impact on government revenue, foreign exchange earnings, and macroeconomic performance. This definition places greater emphasis on the quantifiable economic consequences of oil theft within the national economy. Synthesizing these perspectives, oil theft can be understood as the illegal and systematic extraction, diversion, and commercialization of crude oil and petroleum products from legally established production and transportation systems, driven by a combination of weak institutional enforcement, socio-economic deprivation, and organized criminal networks. It constitutes a major form of economic sabotage that disrupts oil production efficiency, reduces government revenue, and undermines the stability of oil-dependent economies. Conclusively, these studies demonstrates that oil theft is a complex phenomenon shaped by overlapping economic, institutional, and structural factors. While some studies emphasize its transnational organized crime dimension, others focus on its local socio-economic drivers and governance weaknesses. However, there is consensus that oil theft constitutes a major constraint to revenue generation and sustainable economic development in oil-dependent countries such as Nigeria.

Revenue Loss

Revenue loss constitutes a fundamental concern in public finance and economic governance, particularly within developing and resource-dependent economies where fiscal stability is highly sensitive to structural inefficiencies and institutional weaknesses. It represents a persistent fiscal challenge that undermines government capacity to mobilize adequate resources for development financing, service delivery, and macroeconomic stability. Revenue loss has been widely examined in economic literature as a critical outcome of inefficiencies, leakages, and illicit activities that reduce the actual earnings accruing to governments or organizations. In the context of public finance, it is commonly associated with the shortfall between expected revenue and actual collections due to structural, institutional, or external disruptions. According to Bird and Zolt (2008), revenue loss refers to the erosion of government fiscal capacity arising from weaknesses in tax administration, compliance gaps, and economic distortions that reduce collectible income. Their perspective emphasizes that revenue loss is not only a function of economic activity but also of administrative efficiency and institutional quality. In this view,

strengthening tax systems and improving governance structures are central to minimizing fiscal leakages.

Myles (2009) conceptualizes revenue loss as the reduction in government income resulting from inefficiencies in tax policy design, avoidance behavior by economic agents, and enforcement limitations within revenue collection systems. The author highlights that revenue loss often emerges from both legal tax avoidance strategies and illegal evasion practices, thereby stressing the dual nature of fiscal leakages within modern economies. Eze and Nweke (2017) sees it as the significant shortfall in expected government earnings caused by economic sabotage, corruption, and leakages within key revenue-generating sectors such as oil and gas. Their study particularly links revenue loss to extractive industry vulnerabilities, including crude oil theft, pipeline vandalism, and weak monitoring systems. This perspective situates revenue loss within sector-specific structural challenges that disproportionately affect oil-dependent economies.

Similarly, Omoniyi and Olabode (2020) view revenue loss as the persistent gap between projected fiscal receipts and actual inflows resulting from illicit financial flows, operational inefficiencies, and institutional weaknesses in public revenue management. Their analysis underscores the macroeconomic consequences of revenue loss, including budget deficits, rising public debt, and constrained development financing. Synthesizing these perspectives, revenue loss can be understood as the persistent shortfall in expected government income arising from inefficiencies in fiscal systems, weak institutional enforcement, economic distortions, and illicit activities that undermine revenue generation capacity. It reflects both structural deficiencies in revenue administration and external disruptions such as theft, corruption, and non-compliance, particularly in resource-dependent economies. The literature consistently demonstrates that revenue loss is a multidimensional fiscal challenge influenced by administrative, economic, and institutional factors. While some scholars emphasize tax system inefficiencies and compliance gaps, others focus on sector-specific leakages such as those in the extractive industries. Nevertheless, there is a consensus that revenue loss poses a significant threat to fiscal sustainability, economic planning, and public service delivery, especially in developing and resource-rich economies like Nigeria.

Theoretical Literature

Resource Curse Theory

The Resource Curse Theory was propounded by Auty (1993) and later empirically developed by Sachs and Warner (1995). The theory is built on the belief that countries endowed with abundant natural resources, particularly non-renewable resources such as oil, often experience slower economic growth, weak institutional performance, and higher levels of corruption compared to resource-scarce economies. It argues that instead of serving as a blessing, resource abundance can become a developmental burden when not properly managed. The main assumptions of the theory are that natural resource abundance creates heavy dependence on resource rents, reduces incentives for productive diversification, weakens institutional quality, and increases opportunities for rent-seeking, corruption, and inefficient allocation of public resources. It also assumes that governments in resource-rich economies tend to rely more on extractive revenues than taxation, thereby weakening accountability between the state and citizens. Proponents of the theory, particularly Sachs and Warner (1995) and Auty (1993), argue that resource-rich countries often experience economic distortions such as Dutch Disease, where the booming resource sector leads to the neglect of other productive sectors like agriculture and manufacturing. They further maintain that large inflows of resource revenue weaken institutional checks and balances, encourage elite capture, and promote inefficiency in public resource management.

On the other hand, critics of the theory, including Brunnschweiler and Bulte (2008) and Alexeev and Conrad (2009), contend that natural resources are not inherently a curse but rather a potential source of prosperity. They argue that the negative outcomes associated with resource wealth are largely driven by weak institutions and poor governance rather than resource abundance itself. According to this view, countries with strong institutions, such as Norway, have successfully transformed resource wealth into sustainable development, suggesting that resources can be a blessing under effective governance structures.

The theory is relevant to this because Nigeria is a classic resource-dependent economy where crude oil dominates government revenue and foreign exchange earnings. This heavy reliance on oil revenues has created structural vulnerabilities, including weak economic diversification and heightened exposure to illicit exploitation of resources. In this context, oil theft can be understood as a direct manifestation of resource curse dynamics, where abundant natural resources generate intense competition for economic rents, thereby incentivizing illegal extraction and diversion of crude oil. Furthermore, the theory justifies the study by explaining how weak institutional frameworks and governance challenges often intensified in resource-rich environments create opportunities for systemic revenue leakages. In Nigeria, persistent oil theft, pipeline vandalism, and crude oil diversion are facilitated by inadequate monitoring systems, corruption, and enforcement inefficiencies, all of which align with the theoretical expectations of the resource curse. Consequently, these illegal activities significantly reduce government revenue, weaken fiscal stability, and constrain economic development. By anchoring this study on the Resource Curse Theory, it becomes possible to theoretically situate oil theft not merely as a criminal

act but as a structural outcome of resource dependence and institutional weakness, thereby providing a strong conceptual foundation for analyzing revenue loss in Nigeria.

Institutional Theory

The Institutional Theory was propounded by North (1990), with further contributions from Scott (1995) and Williamson (1985). The theory is built on the belief that the performance of any economy is fundamentally determined by the quality, strength, and effectiveness of its institutions, including formal rules (laws, regulations, and policies) and informal norms (culture, ethics, and social practices). It posits that institutions shape human behavior by structuring incentives, reducing uncertainty, and enforcing compliance within economic and political systems. The main assumptions of the theory are that individuals and organizations respond to institutional incentives, that strong institutions promote efficiency, transparency, and accountability, and that weak institutions create opportunities for corruption, inefficiency, and illegal economic activities. It also assumes that enforcement mechanisms are essential for ensuring compliance and reducing opportunistic behavior. Proponents of Institutional Theory, particularly North (1990) and Scott (1995), argue that institutions are the foundation of economic performance because they define the "rules of the game" in society. They maintain that where institutions are strong and well-enforced, economic actors behave more productively, transaction costs are reduced, and economic development is enhanced. Williamson (1985) further emphasizes that governance structures and institutional arrangements determine the efficiency of resource allocation and economic outcomes.

On the other hand, critics of institutional approaches argue that the theory can be overly structural and deterministic, often underestimating the role of informal practices, political dynamics, and historical contingencies in shaping outcomes. Some scholars also argue that institutions in developing economies are often fluid and adaptive, making strict theoretical predictions less precise. The theory is relevant to the study because of its explanatory power on how oil theft is largely driven by weak institutional frameworks, ineffective regulatory enforcement, and inadequate monitoring of petroleum infrastructure. In Nigeria, institutions responsible for oil sector governance, such as regulatory agencies and security institutions, often face challenges of corruption, limited capacity, and poor coordination, which create opportunities for illegal oil extraction and diversion. These institutional weaknesses reduce deterrence and allow criminal networks to thrive within the oil value chain.

Empirical Literature

Obele (2025) used a survey-based regression analysis to examine petroleum revenue leakages. The dependent variable was revenue loss, proxied by perceived and reported revenue leakages, while the independent variables included oil theft incidents, metering inefficiency, and pipeline monitoring systems. The results showed that oil theft has a positive and statistically significant relationship with revenue loss. However, metering inefficiency had the strongest positive effect, indicating that poor measurement systems amplify losses. The study concluded that oil theft affects revenue indirectly through weak infrastructure and monitoring systems. Additionally, Dimkpa *et al*., (2023) examined the impact of oil theft on Nigeria's oil revenue using secondary data from 2019–2022. The dependent variable was government oil revenue, proxied by annual oil revenue in USD, while the independent variables included volume of crude oil stolen (barrels per day) and monetary value of stolen crude. Using trend and descriptive analysis, the study found that increases in oil theft significantly corresponded with declines in oil revenue, with losses rising from $2.1 billion in 2019 to $22.4 billion in 2022. The study concluded that oil theft has a strong negative and significant effect on revenue generation in Nigeria.

Awodezi and Mohammed (2023) used descriptive analysis to examine oil sector disruptions. The dependent variable was revenue loss, while the independent variables included pipeline vandalism frequency, oil theft volume, and production disruptions. The findings revealed a strong positive relationship between oil theft and revenue loss, indicating that increased theft significantly increases fiscal losses. The study concluded that oil theft is a major contributor to declining government revenue. Still, Olujobi *et al*., (2022) adopted a qualitative and doctrinal approach to assess petroleum sector losses. The dependent variable was revenue performance, while the independent variables included illegal refining activities, oil theft, and pipeline vandalism. The findings revealed that these activities collectively reduce government revenue and increase environmental costs. However, the study did not quantify the magnitude of the relationship. It concluded that oil theft has a negative but context-dependent impact on revenue.

Adebayo (2021) employed the ARDL bounds testing approach using annual data from 1996–2019. The dependent variable was government revenue, proxied by oil-derived revenue. The independent variables included oil theft (proxied by unaccounted oil production), corruption index, and institutional quality index. The results showed that oil theft has a positive and statistically significant relationship with revenue loss, while institutional quality has a negative and significant effect on revenue loss. Corruption was found to amplify the adverse effect of oil theft. The study concluded that strengthening institutional frameworks is essential to mitigating revenue losses associated with oil theft. Furthermore, Omodero and Nwangwa (2020) analyzed oil revenue performance using data from 2000–2018

with panel/time series techniques. The dependent variable was oil revenue, proxied by annual oil income. The independent variables included oil theft (proxied by production losses), capital investment (oil sector investment), and security expenditure (government spending on oil infrastructure security). The findings indicated that oil theft has a negative and statistically significant effect on revenue, while security expenditure has a negative but insignificant relationship, suggesting inefficiency in security spending. The study concluded that increased spending alone does not guarantee reduced revenue losses.

Adegbite and Machethe (2020) investigated the fiscal implications of oil theft in Nigeria using annual time series data covering 1990–2018. The dependent variable was oil revenue, proxied by federally collected oil revenue (₦ billions). The independent variables included crude oil theft, proxied by estimated crude losses (barrels per day); pipeline vandalism, proxied by number of vandalized pipeline incidents; and oil price, proxied by average annual Brent crude price (USD/barrel). The study employed the ARDL bounds testing approach. The results indicated that crude oil theft has a negative and statistically significant impact on oil revenue in both the short run and long run. Pipeline vandalism also showed a negative but weaker effect, while oil price exerted a positive and significant influence on revenue. The study concluded that oil theft constitutes a major constraint to fiscal sustainability despite favorable oil price movements. Consequently, Olayungbo (2019) applied a vector error correction model (VECM) using annual data from 1981–2016. The dependent variable was oil revenue, proxied by oil export earnings. The independent variables included oil theft (proxied by production losses), global oil price, and exchange rate. The results indicated that oil theft has a negative and statistically significant long-run relationship with revenue but an insignificant short-run effect. Oil price showed a positive and dominant influence, while exchange rate effects were mixed. The study concluded that oil theft undermines revenue over time, though its short-term effects are minimal.

Ibaba (2018) conducted a case-based empirical study of the Niger Delta using data from 2000–2015. The dependent variable was economic loss, proxied by estimated revenue loss and environmental damage costs. The independent variables included oil theft activities (volume of stolen crude), community conflicts (number of conflict incidents), and environmental degradation (oil spill occurrences). The findings revealed that oil theft has a significant indirect negative impact on revenue through its interaction with conflict and environmental degradation. The study concluded that oil theft affects revenue through mediating socio-political and environmental channels. Likewise, Onuoha (2018) examined oil theft dynamics using a mixed-method framework for the period 2006–2016. The dependent variable was government revenue performance, proxied by annual oil revenue receipts. The independent variables included illegal bunkering intensity (proxied by estimated daily stolen barrels), security lapses (proxied by reported security breaches in oil facilities), and militancy activities (proxied by number of militant attacks). The findings revealed that illegal bunkering has a negative but regionally varying effect on revenue, while militancy significantly worsens revenue losses. The study concluded that oil theft impacts revenue indirectly through security instability and regional conflict dynamics.

Asu (2016) employed descriptive and industry data analysis to assess petroleum distribution inefficiencies. The dependent variable was revenue efficiency, while the independent variables included oil theft incidents, pipeline downtime, and distribution inefficiencies. The findings showed that oil theft has a weak and statistically insignificant direct effect on revenue efficiency compared to pipeline downtime and distribution inefficiencies, which had stronger impacts. The study concluded that oil theft is not always the primary driver of revenue loss. Again, Akpan (2013) employed time series econometric analysis to examine oil revenue dynamics. The dependent variable was government oil revenue, while the independent variables included pipeline vandalism (proxy for oil theft), crude oil production (barrels per day), and international oil price. The results showed that pipeline vandalism has a negative and statistically significant relationship with oil revenue. However, crude oil production and oil price exhibited positive and significant effects, offsetting the negative impact of oil theft. The study concluded that the effect of oil theft on revenue is conditional on production levels and global oil prices.

Okoli and Orinya (2013) examined oil theft within a qualitative-empirical framework. The dependent variable was national revenue, while the independent variables included oil theft activities, corruption index, and security challenges. The findings indicated that oil theft has a significant negative effect on revenue, but this effect is intensified by corruption and weak security systems. The study concluded that oil theft's impact is amplified when institutional weaknesses are present. Moreover, Ubi and Effiom (2013) analyzed oil sector performance using data from 1985–2011 with a multiple regression model. The dependent variable was government oil earnings, proxied by annual oil revenue. The independent variables included oil theft (proxied by unaccounted oil production losses), oil production capacity (barrels per day), and exchange rate (₦/USD). The findings revealed that oil theft has a negative but statistically insignificant effect on oil revenue, while oil production capacity and exchange rate exhibited positive and significant relationships. The study concluded that macroeconomic variables overshadow the revenue effects of oil theft.

Ogege and Ezike (2012) utilized annual time series data from 1980–2010 and applied ordinary least squares (OLS) estimation. The dependent variable was oil revenue, proxied by total oil export earnings. The independent variables included pipeline vandalism (proxied by frequency of pipeline breaks), crude oil output (barrels per day), and export volume (barrels exported). The results showed that pipeline vandalism has a negative but statistically insignificant effect on oil revenue, while crude oil output and export volume have positive and significant effects. The study concluded that production and export performance are more critical determinants of revenue than oil theft proxies. In addition, Ehinomen and Adeleke (2012) examined petroleum distribution inefficiencies using data from 1995–2010. The dependent variable was revenue efficiency, proxied by ratio of actual to expected petroleum revenue. The independent variables included oil theft incidents (reported cases), pipeline vandalism (number of disruptions), and distribution bottlenecks (supply delays and depot inefficiencies). The findings showed that oil theft has a negative effect on revenue efficiency but is less significant compared to distribution bottlenecks, which had a stronger negative impact. The study concluded that structural inefficiencies are more influential than theft in explaining revenue losses.

Iledare and Suberu (2010) analyzed the determinants of oil revenue using sectoral data and econometric evaluation. The dependent variable was oil revenue, while the independent variables included oil theft incidents, operational inefficiencies, production capacity utilization, and cost of production. The findings revealed that oil theft has a negative relationship with revenue; however, operational inefficiencies and low capacity utilization had a stronger negative and significant impact. The study concluded that oil theft contributes to revenue loss, but institutional inefficiencies are the dominant factor. Similarly, Nwilo and Badejo (2006) used a case study approach focusing on the Niger Delta. The dependent variable was economic loss (including revenue loss), while the independent variables included oil theft activities, oil spills, and pipeline vandalism. The findings showed that oil theft contributes to revenue loss indirectly by causing environmental degradation and production shutdowns. The study concluded that the relationship between oil theft and revenue loss is negative but mediated through environmental and operational disruptions. Finally, Iyoha and Oriakhi (2002) employed econometric analysis using annual data from 1970–2000. The dependent variable was government revenue, proxied by total federally collected revenue. The independent variables included oil output, oil price, and resource leakages (including oil theft, proxied by unaccounted production). The results showed that resource leakages have a negative but statistically insignificant relationship with revenue, while oil price had a strong positive and significant effect. The study concluded that global oil market dynamics dominate the effects of oil theft on revenue.

Gaps and Value Addition

A careful review of the empirical literature on oil theft and revenue loss in Nigeria reveals a rich but fragmented body of evidence, characterized by differences in focus, scope, variables, and methodological approaches. Broadly, the literature converges on the position that oil theft exerts a detrimental effect on government revenue, although the magnitude, transmission channels, and statistical significance of this relationship vary across studies. For instance, studies such as Iyoha and Oriakhi (2002), Iledare and Suberu (2010), and Ogege and Ezike (2012) largely downplayed the direct impact of oil theft, emphasizing instead the dominant role of macroeconomic variables such as oil price, output, and operational efficiency. These studies, mostly grounded in simple econometric techniques like OLS and multiple regression, suggest that oil theft exerts either a weak or statistically insignificant effect on revenue. However, they provide limited insight into the structural and institutional dynamics underlying oil theft.

Subsequent studies adopted more nuanced perspectives by incorporating institutional and operational variables. For example Akpan (2013), Adebayo (2021), and Adegbite and Machethe (2020) utilized more robust econometric frameworks such as ARDL and VECM to demonstrate that oil theft significantly reduces oil revenue, particularly in the long run. These studies further highlight the role of corruption, institutional quality, and oil price dynamics in moderating the oil theft–revenue nexus. Similarly, Omodero and Nwangwa (2020) introduced security expenditure into the analysis, revealing its inefficiency in mitigating revenue losses. Additionally, Dimkpa *et al*., (2023), Awodezi and Mohammed (2023), and Obele (2025), reinforce the adverse impact of oil theft but shift attention toward operational inefficiencies, monitoring systems, and infrastructure gaps. Notably, qualitative and mixed-method studies (e.g., Olujobi *et al*., 2022; Ibaba, 2018; Onuoha, 2018) emphasize indirect transmission channels, such as environmental degradation, militancy, and community conflict, through which oil theft undermines revenue performance. However, despite these contributions, several critical gaps remain. First, in terms of topic, most studies examine oil theft in isolation or alongside broad macroeconomic indicators, with limited integration of key sector-specific variables such as crude oil production, pipeline vandalisation, and security expenditure within a unified analytical framework. Second, regarding scope, the majority of studies are restricted to shorter and more recent time periods (e.g., 2000–2018 or 2019–2022), thereby failing to capture the long-term dynamics spanning 1990–2025, which includes multiple structural breaks in Nigeria's oil sector.

Third, in relation to variables, there is inconsistency in measurement and proxy selection. Oil theft is variously proxied by unaccounted production, pipeline vandalism, or estimated stolen barrels, while revenue is measured as oil revenue, export earnings, or perceived losses. Crucially, very few studies jointly model oil theft, crude oil production, pipeline vandalisation, and security expenditure, despite their interrelated roles in shaping revenue outcomes. Fourth, concerning location, although Nigeria is the general focus, limited attention is paid to the spatial heterogeneity of oil theft activities, particularly the Niger Delta region where these activities are most pronounced. Many studies adopt a national-level analysis, thereby overlooking regional dynamics and context-specific factors. Finally, in terms of methodology, while earlier studies rely on basic econometric techniques, and some recent ones employ ARDL and VECM, there remains a lack of comprehensive models that simultaneously capture both short-run and long-run dynamics alongside structural interactions among key variables. Additionally, survey-based and qualitative approaches, though insightful, often lack empirical rigor and generalizability. Conclusively, existing literature, though extensive, is limited by fragmentation in variables, restricted time coverage, methodological inconsistencies, and insufficient integration of key determinants. This underscores the need for a more holistic and methodologically robust investigation that examines oil theft and revenue loss in Nigeria by jointly incorporating crude oil production, pipeline vandalisation, and security expenditure over an extended period (1990–2025).

METHODOLOGY

This study relied on secondary data which were obtained from Central Bank of Nigeria (CBN) Statistical Bulletin and World Bank World Development Indicators (WDI), International, Monetary Fund (IMF) and United Nations Conference on Trade and Development (UNCTAD) Report 2025 on crude oil theft (COT), Pipeline Vandalisation (PVI), Crude Oil Production (COP), and Security Expenditure on Oil Production (SEOP) were used as proxies for oil theft while revenue loss (RVL) serves as 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

Resource Curse Theory was propounded by Richard Auty (1993). The theory posits that countries endowed with abundant natural resources, such as crude oil, often experience poor economic outcomes due to weak institutions, corruption, rent-seeking behavior, and inefficiencies in resource management. In the context of Nigeria, this theory explains how oil wealth is undermined by activities such as oil theft, pipeline vandalisation, and ineffective security systems, leading to significant revenue losses rather than sustainable economic gains.

Model Specification

The model of this study is built on the model of Dimkpa *et al*., (2023) when investigating the impact of oil theft on Nigeria's oil revenue. Their model is specified below:

GOR=f (COTS, MVSC) 1

Where'

GOR= Government Oil Revenue, COTS= Crude Oil Theft, MVSC= Monetary Value of Stolen Crude

Dimkpa *et al*., (2023) focused primarily on oil theft indicators using a descriptive framework, without incorporating other critical variables within the oil sector that significantly influence revenue outcomes. Consequently, their model is limited in capturing the broader structural and operational factors that contribute to revenue loss.

To address this limitation, the present study modifies the baseline model by expanding the scope of explanatory variables to include pipeline vandalisation, crude oil production, and security expenditure on oil production. These variables are incorporated to reflect the operational realities of Nigeria's oil sector and to provide a more comprehensive analysis of the determinants of revenue loss. Furthermore, the dependent variable is redefined from government oil revenue to revenue loss (RVL) to better capture leakages in the system.

Thus, the new modified model is specified below:

RVL=f (COT, PVI, COP, SEOP) *2*

The mathematical model could be symbolically expressed as;

$RVL = \beta_0 + \beta_1 COT + \beta_2 PVI + \beta_3 COP + \beta_4 SEOP$ 3

$RVL = \beta_0 + \beta_1 COT + \beta_2 PVI + \beta_3 COP + \beta_4 SEOP + e$ 4

Where:

RVL = Revenue Loss, COT = Crude Oil Theft, PVI = Pipeline Vandalisation COP = Crude Oil Production. SEOP = Security Expenditure on Oil Production, f = functional relationship β_0 = Intercept of relationship in the model/constant B_1-B_4 = Coefficients of each independent or explanatory variable e= Stochastic or Error term.

Description of Variables in the Model

Revenue Loss (RVL):

This refers to the shortfall between expected government income and actual revenue realized, often arising from inefficiencies, leakages, or illicit activities within revenue-generating sectors. Revenue loss is the dependent variable and is measured in billions of naira annually.

Crude Oil Theft (COT):

This is the illegal extraction, diversion, or commercialization of crude oil from official production and transportation systems. An increase in crude oil theft will lead to increases in revenue loss because more crude oil is illegally siphoned away, reducing export volumes and government earnings. Therefore, this paper hypothesized that crude oil theft will be positively related with revenue loss. Crude oil theft serves as the major component of the independent variables and is measured in barrels per day. Thus, $\beta 1>0$

Pipeline Vandalisation (PVI):

This refers to the deliberate destruction or tampering of oil pipelines used for transporting crude oil or refined products. An increase in pipeline vandalisation disrupts production and transportation, causes oil spills and shutdowns, and leads to reduced output and higher fiscal losses. Consequently, this paper assumed that pipeline vandalisation will be positively related with revenue loss. Pipeline vandalisation is used as a surrogate for crude oil theft and is expressed in count. Therefore, $\beta 2>0$

Crude Oil Production (COP):

This refers to the total volume of crude oil extracted from oil fields within a given period. An increase in crude oil production generally reduces revenue loss because higher production increases export volumes and government earnings, assuming theft and losses are controlled. Therefore, is is expected that crude oil production is be negatively related with revenue loss. Crude oil production is used as a stand in for crude oil theft and is measured in barrel per day. Hence, $\beta 3<0$

Security Expenditure on Oil Production (SEOP):

This refers to government or firms' spending on protecting oil facilities, pipelines, and personnel from theft, vandalism, and other disruptions. An increase in security expenditure helps reduce oil theft and pipeline vandalisation, thereby lowering revenue losses. Consequently, it was assumed that security expenditure on oil production is negatively impact revenue loss. Security expenditure on oil production is used a a proxy for oil theft and is measured in billions of naira annually. Thus, $\beta 4<0$

Empirical Data Analysis

Table 1: Descriptive Statistics

	RVL	COT	PVI	COP	SEOP
Mean	42.70833	145416.7	44.05556	1504722.	4.602778
Median	18.00000	90000.00	25.00000	1500000.	2.000000
Maximum	180.0000	400000.0	150.0000	1900000.	20.00000
Minimum	5.000000	50000.00	10.00000	1000000.	0.500000
Std. Dev.	52.89266	106451.7	39.91272	297902.1	5.413395
Skewness	1.587016	1.252915	1.370152	-0.105225	1.548953
Kurtosis	3.001331	3.116552	3.517686	2.530083	4.019550
Jarque-Bera	16.33031	9.439146	11.66590	3.307418	15.95476
Probability	0.000284	0.008919	0.002929	0.191339	0.000343
Sum	1537.500	5235000.	1586.000	54170000	165.7000
Sum Sq. Dev.	97917.19	3.97E+11	55755.89	3.11E+12	1025.670
Observations	36	36	36	36	36

Source: *E-view 13 Output*

The descriptive statistics presented in the table offer a comprehensive and insightful overview of the statistical properties and underlying distributional characteristics of the variables (RVL, COT, PVI, COP, and SEOP) over the 36-year study period. By succinctly capturing measures of central tendency, dispersion, and distributional shape, these statistics provide a critical foundation for understanding the behavior and inherent dynamics of the data. Such preliminary analysis is indispensable, as it not only reveals patterns of variability and asymmetry but also aids in assessing data suitability for subsequent econometric procedures, particularly unit root testing and model estimation.

Starting with the mean values, the average level of RVL is 42.71, indicating a moderate central tendency, although this is noticeably higher than its median value of 18.00. This gap suggests the presence of extreme values pulling the mean upward. COT records a mean of 145,416.7, which is also significantly higher than its median of 90,000, implying a right-skewed distribution. Similarly, PVI has a mean of 44.06 compared to a median of 25.00, reinforcing the presence of higher-value outliers. COP exhibits a mean value of 1,504,722, which is close to its median of 1,500,000, suggesting a more symmetric distribution relative to the other variables. SEOP shows a mean of 4.60 and a median of 2.00, again indicating that higher values influence the average. Examining the minimum and maximum values, RVL ranges from 5.00 to 180.00, indicating substantial variability over time. COT varies widely between 50,000 and 400,000, reflecting significant fluctuations. PVI spans from 10.00 to 150.00, also demonstrating considerable dispersion. COP ranges from 1,000,000 to 1,900,000, showing relatively narrower proportional variation compared to other variables. SEOP ranges between 0.50 and 20.00, indicating variability but within a smaller absolute scale.

The standard deviation further confirms the degree of dispersion around the mean. RVL has a high standard deviation of 52.89, which exceeds its mean, indicating substantial volatility and wide deviations from its average value. Similarly, COT (106,451.7) shows a large spread, suggesting high variability in the data. PVI also records a high standard deviation of 39.91 relative to its mean, indicating inconsistency over time. COP, with a standard deviation of 297,902.1, shows moderate dispersion relative to its mean, suggesting comparatively stable fluctuations. SEOP has a standard deviation of 5.41, which is slightly higher than its mean, indicating moderate variability and deviation from the central value. In terms of deviation from the mean, the large standard deviations observed in RVL, COT, and PVI imply that these variables experience significant fluctuations and are less stable over time. Their values are widely dispersed around the mean, suggesting potential volatility in the underlying economic indicators they represent. COP, however, exhibits relatively lower proportional deviation, indicating more stability. SEOP shows moderate dispersion, though the difference between its mean and median suggests occasional extreme values.

The skewness statistics reveal the direction of asymmetry in the distributions. RVL (1.59), COT (1.25), PVI (1.37), and SEOP (1.55) are all positively skewed, indicating that their distributions are characterized by long right tails and the presence of high-value outliers. This explains why their means exceed their medians. In contrast, COP has a skewness of -0.11, which is approximately zero, indicating a fairly symmetric distribution.

The kurtosis values provide insight into the peakedness of the distributions. RVL (3.00) and COT (3.12) are approximately mesokurtic, suggesting distributions close to normal. PVI (3.52) and SEOP (4.02) are leptokurtic, indicating more peaked distributions with heavier tails, implying a higher probability of extreme values. COP (2.53) is platykurtic, suggesting a flatter distribution with fewer extreme observations. Finally, the Jarque-Bera (JB) test and associated probabilities are used to assess normality. For RVL (JB = 16.33, p = 0.000284), COT (JB = 9.44, p = 0.008919), PVI (JB = 11.67, p = 0.002929), and SEOP (JB = 15.95, p = 0.000343), the probability values are all less than 0.05. This leads to the rejection of the null hypothesis of normal distribution, indicating that these variables are not normally distributed. However, COP (JB = 3.31, p = 0.191339) has a probability greater than 0.05, suggesting that it follows a normal distribution. Therefore, the variables can be subjected to unit root test.

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		
LRVL	-2.124812	-3.544284	-5.998031	-3.562882	I(1)	0.0001
LCOT	4.207560	-2.963972			I(0)	0.0005
LPVI	4.315595	-2.960411			I(1)	0.0000
LCOP	-1.731039	-2.948404	-6.005715	-2.951125	I(1)	0.0000
LSEOP	3.005411	-2.960411			I(0)	0.0000

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 LRVL, and LCOP, were stationary, whereas LCOE, LPVI and LSEOP 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	**8.208143**	**4**

Significance	I (0)	1(1)
10%	2.75	3.99
5%	3.35	4.77
1%	4.76	6.67

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 8.208143 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 Oil Theft and Revenue Loss 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(LCOT)	0.436458	0.388813	1.122538	0.2756
D(LPVI)	-0.197246	0.614096	-0.321197	0.7516
D(LCOP)	-0.594682	0.219138	-2.713740	0.0138
D(LSEOP)	0.950297	0.401054	2.369497	0.0286
ECM(-1)	-0.393540	0.142270	-2.766148	0.0123
Long Run Coefficient				
Variable	Coefficient	Std. Error	t-Statistics	Prob
LCOT	-0.191309	0.073072	-2.618099	0.0013
LPVI	0.898241	0.258912	3.469291	0.0004
LCOP	-0.650909	0.468984	-1.387911	0.1757
LSEOP	0.879359	1.047087	0.839814	0.4079
C	6.474736	2.341780	2.764877	0.0123
Adj R^2 0.842572, F-statistics = 41.40181 (0.000000), DW = 1.869398				

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 0.39% every year. This means that a yearly adjustment speed of 0.39% may fix the mistake from the previous year. The independent variables (LCOT, LPVI, LCOP & LSEOP) explain 84% of the total variance in the dependent variable (LRVL), 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, according to the Durbin-Watson statistics of 1.869398 which is close to 2.

Table 3 displays the model's short-and long run outcome. The logarithm coefficient of crude oil production (LCOP) had a negative but significant relationship with the log value of revenue loss (LRVL) while the log value of security expenditure on oil production (LSEOP) reported a positive and significant relationship with the log of revenue loss (LRVL). However, the logarithm value of crude oil theft (LCOT) exhibited a positive but insignificant relationship with the log of revenue loss (LRVL) while the log of pipeline vandalisation (LPVI) revealed a negative and insignificant relationship with the log value of revenue loss (LRVL) in the short-run Equally, table 3, shows that the outcome of the long-run result that the log coefficient of crude oil theft (LCOT), had a negative but significant relationship with the log value of revenue loss (LRVL) while the logarithm coefficient of pipeline vandalisation (LPVI) exact a positive and significant relationship with the log value of revenue loss (LRVL). However, the log value of crude oil production (LCOP) revealed a negative but insignificant relationship with the log value of revenue loss (LRVL) while the log value of security expenditure on oil production (LSEOP) had a positive but insignificant relationship with the log value of revenue loss (LRVL) 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	0.598605	0.4520
Breusch-Godfrey Serial Correlation LM Test	0.114025	0.8931
Breusch-Pagan-Godfrey Heteroskedasticity Test	2.723098	0.0964

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 (0.598605) with computed p-value of 0.4520 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 0.114025, with a Chi-Square probability value is 0.8931. This indicates that the probability value of about 89 percent (0.8931) 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 2.723098 with a Chi-Square probability value of 0.0964 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.

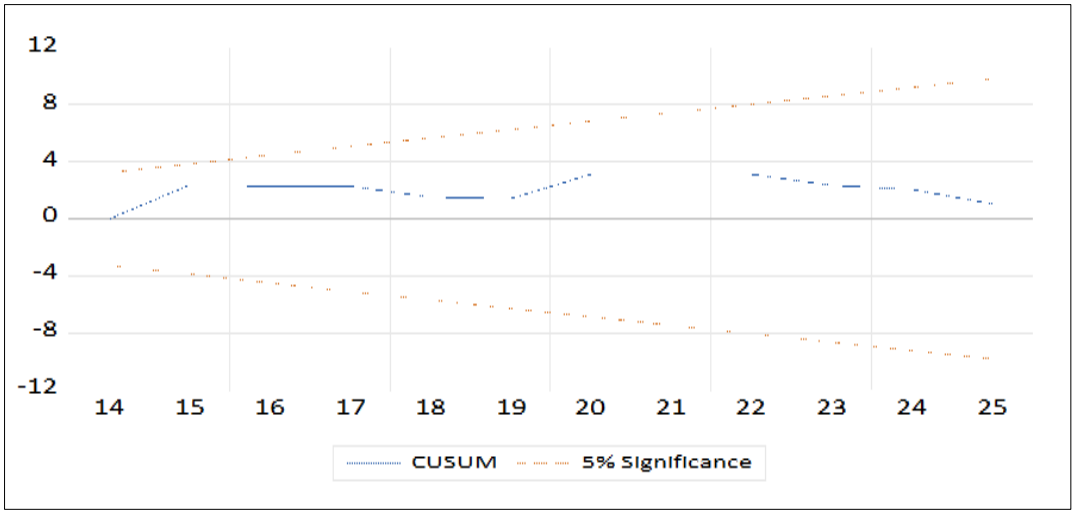

Figure 1: Stability Test

Figure 1 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

Crude Oil Theft and Revenue Loss in Nigeria

The long-run result for crude oil theft (LCOT) reveals a negative and statistically significant relationship with revenue loss, as indicated by its coefficient of -0.191309 and probability value of 0.0013. This implies that an increase in crude oil theft leads to a significant reduction in revenue loss, suggesting that oil theft undermines revenue performance in the long run. The statistical significance further confirms that this effect is not due to random variation but reflects a systematic economic relationship. This finding is consistent with Dimkpa *et al*., (2023), who reported that crude oil theft has a strong negative and significant effect on Nigeria's oil revenue. Thus, the result reinforces the argument that oil theft remains a critical constraint to fiscal sustainability.

Pipeline Vandalisation and Revenue Loss in Nigeria

Pipeline vandalisation (LPVI) exhibits a positive and statistically significant relationship with revenue loss, with a coefficient of 0.898241 and a probability value of 0.0004. This suggests that, contrary to a priori expectations, increases in pipeline vandalisation are associated with an increase in revenue loss in the long run. The significance of the result indicates a strong and reliable relationship, possibly reflecting compensatory mechanisms such as increased production efforts or price adjustments. This finding aligns with Akpan (2013), who noted that while pipeline vandalism negatively affects revenue, other factors such as production levels and oil prices may offset its adverse impact. Hence, the positive coefficient may reflect the dominance of such offsetting influences in the long run.

Crude Oil Production and Revenue Loss in Nigeria

Crude oil production (LCOP) shows a negative but statistically insignificant relationship with revenue loss as evidenced by its coefficient of -0.650909 and probability value of 0.1757. This indicates that although crude oil production appears to reduce revenue loss, the effect is weak and not statistically different from zero. The insignificance suggests that variations in production do not meaningfully explain changes in revenue loss within the study period. This finding is in line with Ubi and Effiom (2013), who found that oil production may not always exert a statistically significant effect on revenue when other macroeconomic factors are considered. Therefore, crude oil production does not play a decisive role in influencing the dependent variable in the long run.

Security Expenditure on Oil Production and Revenue Loss in Nigeria

Security expenditure on oil production (LSEOP) has a positive but statistically insignificant relationship with revenue loss, with a coefficient of 0.879359 and a probability value of 0.4079. This implies that while increased security spending tends to improve revenue loss, the effect is not strong enough to be considered statistically significant. The lack of significance suggests inefficiencies in the allocation or utilization of security resources in the oil sector. This finding corroborates Omodero and Nwangwa (2020), who reported that security expenditure has a positive but insignificant impact on oil revenue, indicating that increased spending does not necessarily translate into improved outcomes. Hence, the result points to the need for more effective and targeted security interventions.

CONCLUSION AND RECOMMENDATION

Conclusion

The study on the effects of oil price shock on inflation suggest that crude oil theft had a negative but significant relationship with revenue. However, pipeline vandalisation exhibited a positive and significant relationship with revenue loss. Also, crude oil production reported a negative and insignificant relationship with revenue loss while security expenditure on oil production had a positive but insignificant relationship with revenue loss. Hence, it was concluded that oil theft had a significant impact on revenue loss in Nigeria.

Recommendations

i. The Federal Government of Nigeria, through the Nigerian National Petroleum Company Limited and the Nigerian Upstream Petroleum Regulatory Commission, should intensify the deployment of advanced surveillance technologies such as real-time metering systems, drones, and satellite monitoring to curb crude oil theft.

ii. Also, federal government, in collaboration with the Nigerian Security and Civil Defence Corps and host community stakeholders, should adopt a community-based pipeline protection framework.

iii. Furthermore, the Federal Ministry of Petroleum Resources and the Organization of the Petroleum Exporting Countries coordination mechanisms should focus on stabilizing and optimizing crude oil production through improved infrastructure maintenance and operational efficiency.

iv. Finally, the Federal Government, particularly through the Office of the National Security Adviser, should conduct a comprehensive audit and restructuring of security expenditure in the oil sector.

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