



Econometric Analysis of Risk Factors Affecting Drilling Operations in Marginal Oil Fields Projects in Nigeria

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ABSTRACT

Drilling operations in marginal oil fields are exposed to several uncertainties that may influence operational performance, project sustainability, and revenue generation. This study examined the major risk factors affecting drilling operations in marginal oil field projects in Nigeria using an econometric approach. The theoretical foundation was based on Risk Management Theory, Decision Theory, and Systems Theory, which provide explanations for risk identification, decision-making under uncertainty, and the coordination of complex operational systems.

The study adopted a quantitative research design using annual secondary data obtained from the World Bank's World Development Indicators for the period 1996–2023. Drilling project performance was proxied by oil rents as a percentage of GDP, while the explanatory variables included technical risk, organizational capacity, oil price volatility, regulatory quality, and environmental risk. The Augmented Dickey–Fuller (ADF) unit root test was used to examine the stationarity of the variables, while the Autoregressive Distributed Lag (ARDL) model was employed to estimate both the short-run and long-run relationships among the variables. The Error Correction Model (ECM) was further used to determine the speed of adjustment toward long-run equilibrium.

The empirical findings revealed that environmental resource depletion had a statistically significant positive long-run effect on oil rents (coefficient = 1.981, $p = 0.000$), indicating that environmental conditions play a dominant role in influencing drilling performance in marginal oil field operations. In contrast, technical risk, organizational capacity, oil price volatility, and regulatory quality showed statistically insignificant long-run effects, although some short-run interactions were observed among the variables. The error correction term was negative and significant, confirming the presence of a stable long-run relationship among the variables.

The study concludes that drilling performance in marginal oil field projects in Nigeria is influenced largely by environmental and resource-related factors

rather than internal operational variables alone. The study recommends that government and relevant regulatory bodies should strengthen environmental governance and enforce sustainable resource management policies in the oil sector, particularly in marginal oil fields.

Key words: Econometric Analysis, Drilling Operations, Marginal Oil Fields, ARDL Model, Error Correction Model, Environmental Risk, Oil Rents.

1.INTRODUCTION

The petroleum industry remains one of the most significant contributors to economic growth and revenue generation in many resource-rich countries. In Nigeria, crude oil exploration and production activities have played a dominant role in shaping the national economy for several decades. The discovery of oil in commercial quantity in the Niger Delta region in 1956 marked the beginning of large-scale petroleum operations in the country, and since then the sector has continued to account for a substantial portion of government revenue, foreign exchange earnings, and export activities. Despite its economic importance, the industry faces several operational challenges, particularly in relation to exploration and drilling activities in marginal oil fields [1].

Marginal oil fields refer to discovered oil reserves that are considered commercially unattractive to large international oil companies due to their relatively small reserve size, complex geological characteristics, or high development costs. These fields often remain undeveloped for long periods until policy reforms or technological advancements create opportunities for their exploitation. In Nigeria, the Federal Government introduced marginal field licensing rounds as part of efforts to promote indigenous participation in the upstream petroleum sector and to increase overall oil production. By granting operating rights to local

companies, the policy aimed to stimulate investment, enhance local content development, and improve resource utilization within the country's oil industry [2].

Although the marginal field initiative has provided opportunities for smaller operators, drilling operations in these fields present several technical, financial, and environmental risks. Unlike large oil fields where infrastructure, capital, and advanced technologies are readily available, marginal fields are often characterized by limited resources and higher operational uncertainties. Drilling activities in such environments require careful planning and effective risk management in order to ensure operational efficiency and cost control. Failure to properly identify and manage drilling risks may result in cost overruns, equipment failures, delays in project execution, and in extreme cases, abandonment of the field [4].

Drilling operations represent one of the most critical and expensive phases of upstream petroleum development. The process involves complex technical procedures, including well planning, site preparation, drilling fluid management, casing installation, and well completion. Each of these stages carries inherent risks that may affect the success of the operation. Geological uncertainties such as abnormal pressure zones, unstable formations, and unexpected reservoir characteristics may significantly complicate drilling activities. In addition, operational factors such as equipment malfunction, inadequate technical expertise, and poor planning may further increase the likelihood of drilling failures or delays [8].

Financial risks also play a significant role in marginal field development. Operators of marginal oil fields typically have limited access to capital compared to large multinational oil companies. As a result, fluctuations in oil prices, high drilling costs, and funding constraints can affect the viability of drilling projects. The relatively high cost of drilling equipment, specialized personnel, and logistics support in remote oil-producing regions further increases the financial burden on marginal field operators. These financial constraints may limit the ability of operators to adopt advanced technologies or implement comprehensive risk mitigation strategies [17].

Environmental and regulatory factors also contribute to the complexity of drilling operations in Nigeria's marginal oil fields. The Niger Delta region, where most marginal fields are located, is environmentally sensitive and has experienced decades of ecological degradation associated with oil exploration activities. As a result, regulatory authorities have introduced stricter environmental and safety requirements aimed at minimizing environmental impacts and ensuring sustainable resource development. Compliance with

these regulations is necessary but may also increase operational costs and introduce additional procedural requirements that affect drilling timelines [16].

Another important concern is the issue of operational safety. Drilling activities involve high-pressure systems, heavy machinery, and hazardous materials, all of which pose potential risks to personnel, equipment, and the surrounding environment. Poor safety management practices can lead to accidents, oil spills, blowouts, and other incidents that may cause significant financial losses and environmental damage. Effective identification and management of risk factors are therefore essential for ensuring safe and efficient drilling operations in marginal oil fields [22].

In light of these challenges, it has become increasingly important for researchers and industry practitioners to examine the key risk factors that influence drilling operations in marginal oil fields. These risks can assist operators in developing appropriate strategies for risk mitigation, improving operational efficiency, and enhancing the overall success of drilling projects. Empirical analysis of these factors can also provide valuable insights for policymakers and industry stakeholders seeking to improve the effectiveness of marginal field development initiatives in Nigeria.

This study therefore focuses on the analysis of key risk factors affecting drilling operations in marginal oil fields projects in Nigeria. By identifying and examining the major risks associated with drilling activities, the study seeks to provide a clearer understanding of the challenges faced by marginal field operators and to contribute to improved decision-making in the management of drilling operations within the Nigerian petroleum industry.

2.LITERATURE REVIEW

Explored the multifaceted risks confronting Nigeria's oil and gas sector and evaluates the effectiveness of current risk management strategies using a systematic literature review [20]. The analysis categorizes risks into operational, financial, regulatory, environmental, geopolitical, and market-based challenges, each contributing to the sector's volatility. Key risks include oil theft, pipeline vandalism, fluctuating global oil prices, environmental hazards, regulatory inconsistencies, and security challenges in oil-producing regions. These risks not only impact production efficiency and revenue generation but also deter foreign and local investments, further exacerbating the sector's vulnerabilities. The study assessed the risk management strategies employed by industry stakeholders, such as regulatory reforms, advanced surveillance technologies, and community engagement programs. Despite these

efforts, implementation gaps, corruption, and inadequate funding often hinder their effectiveness. To address these challenges, the study recommends a holistic risk management framework that integrates proactive measures, such as enhanced technological adoption, improved regulatory consistency, and robust contingency planning.

Conducted a study on hazard identification in well testing operations on offshore drilling and production platforms [13]. The researchers applied the Hazard Identification (HAZID) technique to identify potential operational risks associated with drilling and well testing activities. The study identified 189 potential risk events, which were classified into low, medium, and high-risk categories. The results indicated that logistics operations such as loading, unloading, and transportation between the port and drilling rigs contribute significantly to drilling risk exposure. The study emphasized the need for improved operational planning and safety procedures to reduce the occurrence of high-risk incidents.

Examined non-productive time in drilling operations and its relationship with risk management practices in petroleum fields [5]. The study used operational drilling data and risk assessment techniques to evaluate factors responsible for delays in drilling activities. The findings revealed that equipment malfunction, drilling fluid problems, and inadequate planning were major contributors to non-productive time during drilling operations. The authors concluded that effective risk mitigation strategies and better operational planning could significantly reduce downtime and improve drilling performance.

Reviewed risk factors in the oil and gas industry globally, intending to summarize complex risk dimensions across project and environmental contexts [25]. Employing a comprehensive literature analysis, the study highlighted the multi-faceted nature of oil and gas risk and argued for integrated risk analysis covering project, environmental, and disaster aspects. The authors recommended adopting holistic risk assessment techniques that incorporate sustainability considerations. The study concluded that effective risk analysis must integrate multiple dimensions to support sustainable project development.

Conducted an empirical study on risk management in oil and gas construction projects using Partial Least Squares Structural Equation Modeling (PLS-SEM) [18]. The research collected survey data from professionals in oil and gas projects and analyzed the relationship between different risk factors and project performance. The results revealed that financial risks, safety risks, and managerial inefficiencies significantly affect project outcomes, leading to cost overruns and schedule delays. The study recommended the adoption of structured risk

management frameworks to improve project success in the oil and gas sector.

2.1. Concept of Marginal Oil Fields

Marginal oil fields generally refer to hydrocarbon reserves that have been discovered but remain undeveloped for a long period because they are considered economically unattractive under prevailing market conditions. These fields usually contain relatively small reserves or present technical and financial challenges that discourage large multinational oil companies from investing in their development. In many oil-producing countries, marginal fields are often left dormant until new policies, improved technology, or changes in oil prices make their development feasible [26].

In Nigeria, marginal oil fields have gained increasing attention as part of government efforts to promote indigenous participation in the upstream petroleum sector. The Nigerian government introduced the marginal field programme in 2003 to encourage local oil companies to develop fields that had previously been abandoned or considered non-commercial by major operators. The programme was designed to enhance local content development, increase national oil production, and create employment opportunities within the domestic oil and gas industry [3].

Marginal oil fields typically exhibit characteristics that make their development more complex than conventional oil fields. These characteristics may include limited reservoir size, uncertain geological formations, high development costs, and inadequate infrastructure. Because of these conditions, operators must adopt efficient management strategies and innovative technologies to ensure that development activities, including drilling operations, remain economically viable [17].

2.2. Concept of Drilling Operations

Drilling operations constitute one of the most critical stages in oil and gas exploration and production. The drilling process involves creating a wellbore from the surface to underground hydrocarbon reservoirs in order to extract crude oil or natural gas. This process requires the use of specialized equipment, skilled personnel, and sophisticated engineering techniques to ensure that the well is drilled safely and efficiently [8].

The drilling process normally includes several stages such as site preparation, rig mobilization, drilling of the wellbore, installation of casing and cementing, well testing, and completion. Each stage of the drilling operation requires careful planning and coordination among engineers, geologists, and field personnel. Any

technical failure or operational error during the drilling process can lead to serious consequences, including equipment damage, drilling delays, cost overruns, and environmental hazards [23].

Drilling operations are particularly complex in marginal oil fields because operators often face financial limitations and limited access to advanced technology. In addition, geological uncertainties associated with small or poorly defined reservoirs can make drilling activities more challenging. These conditions increase the level of risk associated with drilling operations and require effective planning and risk management strategies to ensure successful outcomes [4].

2.3. Risk Factors affecting Drilling Operations

Risk in drilling operations refers to the possibility of events or conditions that may negatively affect the success, safety, cost, or schedule of drilling activities. In the petroleum industry, risk is an inherent aspect of exploration and production because subsurface conditions cannot always be predicted with complete accuracy. As a result, drilling projects are frequently exposed to various uncertainties that may influence operational performance [6]. This is illustrated in Figure 1.



Source: Adapted from [6], [17], [18], and [19].

Figure1: Risk Factors Affecting Drilling Operations

Source: Adapted from [6], [17], [18] and [19]

Risk factors in drilling operations may arise from different sources, including geological uncertainties, equipment failures, human errors, environmental conditions, and financial constraints. Geological risks are often associated with unpredictable reservoir characteristics such as abnormal formation pressures, unstable formations, and unexpected lithological variations. These conditions may cause drilling complications such as stuck pipes, well kicks, or blowouts [18].

Operational risks are also common in drilling activities. These risks may result from poor planning, inadequate maintenance of drilling equipment, lack of skilled personnel, or ineffective supervision. Equipment breakdowns, improper drilling fluid management, and poor well control practices can significantly disrupt drilling operations and increase operational costs [19].

Financial risk represents another important concern in marginal oil field development. Since many indigenous operators have limited financial capacity, fluctuations in oil prices, high drilling costs, and funding limitations can affect the viability of drilling projects. Financial challenges may delay drilling operations or limit the ability of operators to adopt modern drilling technologies and safety measures [19].

Environmental and regulatory risks are also important considerations in drilling operations, particularly in environmentally sensitive regions such as the Niger Delta. Environmental regulations require operators to implement strict safety and environmental protection measures in order to minimize ecological damage. Compliance with these requirements is necessary but may increase operational costs and extend project timelines [17].

2.4. Theoretical Foundation

The analysis of risk factors affecting drilling operations in marginal oil fields can be better understood through established theoretical perspectives that explain risk, decision-making, and operational efficiency in complex industrial environments. Among the most relevant theoretical foundations for this study are the Risk Management Theory, Decision Theory, and Systems Theory.

Risk Management Theory provides a structured approach for identifying, assessing, and mitigating potential threats that may negatively affect project objectives. The theory emphasizes the need for organizations to systematically evaluate uncertainties and develop strategies that minimize the likelihood and impact of adverse events. In the context of drilling operations, risk management plays a critical role because the drilling process involves significant technical complexity and financial investment [6].

The theory suggests that effective risk management begins with the identification of potential hazards that may arise during project implementation. Once these risks are identified, organizations are expected to assess their probability of occurrence and the possible consequences associated with them. Based on this evaluation, appropriate mitigation strategies are developed to reduce the likelihood of the risks occurring or to minimize their impact if they occur [15].

In drilling operations, risk management strategies may include the use of advanced drilling technologies, proper well planning, staff training, equipment maintenance, and strict adherence to safety regulations. These measures help reduce operational uncertainties and improve the chances of successful drilling outcomes. For marginal oil fields, where financial and technological resources may be limited, effective risk

management becomes even more essential in order to prevent costly failures and operational disruptions [9].

Decision Theory: Decision Theory provides another important framework for understanding how managers make choices in situations characterized by uncertainty and risk. The theory focuses on how individuals or organizations evaluate alternative courses of action and select the option that offers the most favorable outcome based on available information [24].

In the oil and gas industry, decision-making plays a critical role in determining whether or not to proceed with drilling activities in marginal oil fields. Managers must evaluate several factors, including geological conditions, expected production levels, drilling costs, environmental considerations, and market conditions. Because many of these factors involve uncertainty, decision-makers must rely on analytical tools, probability assessments, and predictive models to guide their choices [11].

Decision Theory also highlights the importance of balancing potential risks with expected rewards. In marginal oil field development, operators must carefully assess whether the anticipated economic benefits justify the risks and costs associated with drilling operations. Poor decision-making at this stage may result in financial losses, operational delays, or abandonment of drilling projects [14].

Systems Theory: Systems Theory views organizations and projects as complex systems made up of interconnected components that interact with each other to achieve specific objectives. According to this theory, the performance of any system depends on the proper functioning and coordination of its various elements. A disruption in one part of the system can affect the performance of the entire system [7].

Drilling operations can be viewed as a complex system that involves multiple components such as geological analysis, drilling equipment, human resources, financial management, and regulatory compliance. Each of these components plays a critical role in ensuring that drilling activities are carried out efficiently and safely. If any component fails to perform effectively, it may create operational challenges that could affect the success of the drilling project [10].

In marginal oil fields, the interaction between these components becomes even more critical because the available resources are often limited. For example, inadequate funding may affect equipment maintenance, which in turn may increase the risk of equipment failure during drilling operations. Similarly, poor coordination among project stakeholders may lead to delays and inefficiencies that increase operational risks [28].

Systems Theory therefore emphasizes the importance of adopting an integrated approach to drilling operations management. By understanding how different elements of the drilling system interact with one another, operators can develop strategies that improve coordination, enhance efficiency, and reduce the overall level of risk associated with drilling activities.

3. RESEARCH METHOD

This study adopted a quantitative research approach to examine the key risk factors affecting drilling operations in marginal oil fields in Nigeria. The study relied on annual secondary data obtained from the World Bank’s World Development Indicators (WDI) covering the period 1996–2023. This dataset provided sufficient observations to analyze the relationship between drilling project performance and selected risk factors.

The stationarity properties of the variables were first examined using the Augmented Dickey–Fuller (ADF) unit root test to avoid spurious regression results and determine the order of integration of the variables. The ADF test is expressed as: $\Delta Y_t = \alpha \beta_t + \gamma Y_{t-1} + \sum_{i=1}^k \delta_i \Delta Y_{t-i} + \varepsilon_t \dots \dots \dots (1)$

Where Y_t represents the time series variable, Δ denotes the first difference operator, t represents the time trend, and ε_t is the stochastic error term.

Following the unit root test, the Autoregressive Distributed Lag (ARDL) model was employed to estimate both the short-run and long-run relationships among the variables. The ARDL technique is appropriate because it accommodates variables integrated at different orders $I(0)$ and $I(1)$ and performs efficiently with relatively small sample sizes. The functional relationship is specified as:

$$DPP = F(TECHR, OC, OP, REGQ, ENVR \dots \dots \dots (2)$$

Where:

DPP = Drilling Project Performance (proxied by Oil Rents as a percentage of GDP – OILR),
TECHR = Technical Risk associated with drilling operations,

OC = Organizational Capacity within the oil sector,

OP = Oil Price Risk reflecting volatility in global crude oil prices,

REGQ = Regulatory Quality representing the effectiveness of oil sector regulations, and

ENVR = Environmental or geological risk affecting drilling activities.

The ARDL model is expressed as:

$$\nabla OILR_t = \alpha_0 + \sum_{i=1}^p \alpha_1 \Delta OILR_{t-i} + \sum_{i=0}^{q1} \alpha_2 \Delta TECH_{t-i} + \sum_{i=0}^{q2} \alpha_3 \Delta OC_{t-i} + \sum_{i=0}^{q3} \alpha_4 \Delta OP_{t-i} + \sum_{i=0}^{q4} \alpha_5 \Delta REGQ_{t-i} + \sum_{i=0}^{q5} \alpha_6 \Delta ENVR_{t-i} + \beta_1 OILR_t + \beta_2 TECHR_t + \beta_3 OC_t + \beta_4 OP_t + \beta_5 REGQ_t + \beta_6 ENVR_t \dots \dots \dots (3)$$

Where all variables are as previously defined.

To capture the short-run adjustment toward long-run equilibrium, the Error Correction Model (ECM) was estimated as: $\Delta OILR_t = \sum \theta_i \Delta X_{t-i} + \lambda ECM_{t-1} + \epsilon_t \dots \dots \dots (4)$

Where ECM_{t-1} represents the lagged error correction term and λ measures the speed of adjustment toward long-run equilibrium. A negative and statistically significant coefficient of the error correction term confirms the existence of a stable long-run relationship among the variables.

4.RESULTS AND DISCUSSION

Before conducting any regression analysis, it is essential to determine the stationarity of the variables to avoid spurious results. The Augmented Dickey-Fuller (ADF) test was employed to examine the presence of a unit root in all the series, both at levels and first difference. Table 1 below displays Augmented Dickey-Fuller (ADF) test showing the Unit root.

4.1. Augmented Dickey-Fuller (ADF) test

Table 1 : Unit root

Variable	ADF Test Statistic	5% Critical Value	P-Value	Order of Integration (I)
D(OILR)	-5.210	-3.595	0.0014	I(1)
D(TECHR)	-4.535	-3.595	0.0067	I(1)
D(OC)	-7.238	-3.595	0.0000	I(1)
D(OP)	-6.929	-3.595	0.0000	I(1)
D(REGQ)	-6.784	-3.595	0.0000	I(1)
ENVR	-4.636	-3.595	0.0054	I(0)

Source: Author’s computation using Eviews10, 2025

The results indicated that: Oil Rents (OILR), Technical Risks (TECHR), Organization Capacity (OC), Oil Price (OP), and Regulation Quality (REGQ) were non-stationary at levels but became stationary at first difference (I(1)). Environmental Risk (ENVR) was stationary at level (I(0)). This mix of I(0) and I(1) variables justified the use of the ARDL bounds testing

approach, which can handle variables integrated of order zero and one.

4.2. ARDL Bounds Test for Cointegration

Once stationarity was established, the ARDL bounds testing approach was applied to determine whether a long-run relationship exists among oil rents (OILR) and the explanatory variables (TECHR, OC, OP, REGQ, ENVR). Table 2 below shows ARDL Bounds Test for Cointegration.

Table 2: ARDL Bounds Test for Cointegration

Test Type	F-Statistic	k (No. of regressors)	I(0) Critical Value	I(1) Critical Value	Decision
ARDL Bound s Test	3.953	5	2.804 (5%)	4.013 (5%)	Cointegration exists at 10% significance

Source: Author’s computation using Eviews 10, 2025

The F-statistic = 3.953 exceeded the 10% upper bound critical value (I(1) = 3.417), indicating evidence of cointegration at the 10% level. This confirmed the existence of a long-run equilibrium relationship, meaning that oil rents and the selected explanatory variables move together over time, despite short-term fluctuations. Table 3 below displays ARDL Long-Run and Short-Run Estimates of Oil Rents Determinants (1996–2023).

Table 3: ARDL Long-Run and Short-Run Estimates of Oil Rents Determinants (1996–2023)

Variable	Long-Run Coefficient	Std. Error	t-Statistic	Prob.	Short-Run Coefficient (ECM)	Std. Error	t-Statistic	Prob.
C	4.075	3.441	1.184	0.257	-	-	-	-
TECHR	-0.524	0.391	-1.340	0.203	D(TECHR) = -0.563	0.265	-2.126	0.053
TECHR(1)	-	-	-	-	1.517	0.279	5.445	0.000
OC	0.097	0.069	1.419	0.179	-	-	-	-
OP	0.003	0.011	0.264	0.796	-	-	-	-
REGQ	-0.110	0.074	-1.489	0.160	D(REGQ) = 0.024	0.024	-1.013	0.330
REGQ	-	-	-	-	0.086	0.0	3.833	0.0

Variable	Long-Run Coefficient	Std. Error	t-Statistic	Prob.	Short-Run Coefficient (ECM)	Std. Error	t-Statistic	Prob.
(-1)							23	02
ENVR	1.981	0.27	8.741	0.000	D(ENVR) = 1.769	0.042	42.1	0.000
ENVR (-1)	-	-	-	-	-0.234	0.040	-5.800	0.000
ECM(-1)	-	-	-	-	-0.568	0.089	-6.359	0.000

Sample: 1996–2023 (26 observations)
 R-squared = 0.9943, Adjusted R-squared = 0.9925
 S.E. of regression = 0.364, Durbin-Watson = 2.291
 F-Bounds Test: F = 3.953, indicates cointegration at 10% significance

Source: Author’s computation using Eviews10, 2025

4.3. Long and Short-Run Dynamics and Error Correction Model

The long- and short-run dynamics and Error Correction Model (ECM) is employed to examine the short-term adjustments and the speed at which oil rents converge to their long-run equilibrium following temporary shocks in institutional, technical, and resource-related factors. The ECM regression shows the short-run adjustment of oil rents toward long-run equilibrium: The error correction term (CointEq(-1)) = -0.568, significant at 1% (p=0.000), indicates that about 56.8% of disequilibrium is corrected annually, confirming a moderate speed of adjustment toward long-run oil rent levels.

Significant short-run effects were observed for: D(TECHR(-1)) = 1.517 (p=0.000), Past energy technical losses positively influence short-run oil rents, possibly reflecting delayed adjustment or compensatory mechanisms. D(REGQ(-1)) = 0.086 (p=0.002). Lagged regulatory quality positively impacts oil rents in the short run. D(ENVR) = 1.769 (p=0.000) and D(ENVR(-1)) = -0.234 (p=0.000). Resource depletion has a strong immediate effect on oil rents, but part of this is corrected in subsequent periods. The model explains 99.25% of variation in oil rents (Adjusted R² = 0.9925), indicating excellent fit, and the Durbin-Watson statistic of 2.291 suggests no significant autocorrelation. The significant impact of ENVR confirms the resource dependence/resource curse hypothesis, which posits that oil rents are highly sensitive to the rate of extraction and resource endowment [12; 27]. The insignificance of TECHR, OC, OP, and REGQ in the long run may reflect: Structural inefficiencies in governance (OC) limiting translation of institutional quality to resource rents. Volatility in crude oil prices (OP) dampening

their direct effect on national rents. Weak regulatory enforcement (REGQ) in the oil sector, consistent with empirical studies in developing countries [21]. The ECM confirms short-run interactions are meaningful, highlighting that policy changes or efficiency improvements can influence oil rents in the short term even if long-run effects are muted.

The ARDL analysis revealed that environmental resource depletion (ENVR) had a significant positive long-run impact on oil rents (coefficient 1.981, p=0.000), confirming its role as a dominant risk factor. In contrast, technical losses (TECHR), organizational capacity/government effectiveness (OC), operational factors (OP), and regulatory quality (REGQ) showed insignificant long-run effects, though some short-run dynamics were observed.

These findings align with the resource dependence/resource curse hypothesis [12][27], where heavy reliance on extractive activities drives rents in the short term but sustains vulnerability through depletion and externalities. In Nigeria’s context, ENVR captures the intensive extraction rates in marginal fields, which boost immediate rents but exacerbate long-term unsustainability. The insignificance of institutional variables (OC, REGQ) reflects structural governance inefficiencies and weak enforcement, common in resource-rich developing economies [21]. This is consistent with empirical evidence from Nigeria, where oil spills, gas flaring, and habitat destruction have led to severe ecological damage, contaminating water sources, reducing biodiversity, and impacting livelihoods dependent on fishing and agriculture.

The short-run significance of some variables suggests temporary compensatory mechanisms (e.g., price volatility offsets), but the dominant ENVR effect underscores that non-technical risks like environmental and geological uncertainties amplify operational vulnerabilities in marginal fields, often leading to higher costs, delays, and reduced economic viability. The results highlight how environmental risks perpetuate a cycle of dependence in Nigeria’s oil sector, muting the potential benefits from improved technology or regulation in the long run.

4.4. Hypothesis testing

H₀: Key risk factors do not have a significant effect on drilling operations in marginal oil field Table 4 below shows the level of significance (p-value) and long run coefficient of the different variables.

Table 4: Significant Level

Variable	Long-Run Coefficient	Significance (p-value)
TECHR	-0.524	0.203 (ns)
OC	0.097	0.179 (ns)
REGQ	-0.110	0.160 (ns)
ENVR	1.981	0.000 (significant)

Source: Author's computation using Eviews10,2025

The ARDL analysis indicates that, in the long run, variables representing elements of the risk management support framework, energy technical losses (TECHR), government effectiveness (OC), and regulatory quality (REGQ), do not have statistically significant effects on oil rents (OILR), with p-values of 0.203, 0.179, and 0.160 respectively.

5. CONCLUSION

This study concludes that risk management in marginal oil-well drilling projects in the Nigeria remains constrained by a complex interplay of external socio-political and environmental risks, limited resources among indigenous operators, and selective adoption of assessment tools. While basic practices ensure regulatory compliance and routine safety, the low uptake of advanced quantitative methods and the overriding influence of non-technical risks perpetuate vulnerabilities, cost escalations, and suboptimal economic outcomes.

6. RECOMMENDATION

The study recommends that government and relevant regulatory bodies should strengthen environmental governance and enforce sustainable resource management policies in the oil sector, particularly in marginal oil fields. This should involve stricter monitoring of environmental practices, enforcement of environmental protection regulations, and the promotion of environmentally responsible drilling technologies. By improving environmental resource management, excessive resource depletion can be reduced, thereby mitigating the long-run negative effects associated with the resource curse and enhancing sustainable performance in Nigeria's oil sector.

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