

Navigating the Regulatory-Legitimacy Nexus: The Role of Institutional Voids and Weak Regulatory Enforcement in Shaping Sustainable Petroleum Supply Chains in Emerging Economies

Author

Abi Cit

Date: September 2, 2026

Abstract

The petroleum industry in emerging economies operates within a complex environment where institutional voids and weak regulatory enforcement create significant barriers to sustainable supply chain management (SCM). Despite increasing global pressure for environmental, social, and governance (ESG) compliance, petroleum firms in developing nations struggle to implement sustainability practices due to fragmented regulatory frameworks, corruption, and legitimacy challenges. This study investigates how institutional voids and weak enforcement shape sustainability outcomes in petroleum supply chains, drawing on institutional theory and legitimacy theory as analytical lenses. Using a mixed-methods approach combining survey data from 144 oil and gas firms in Nigeria and qualitative content analysis of annual reports from 15 global petroleum titans spanning 10 years, the research identifies coercive and normative pressures as significant drivers of sustainability adoption ($p < 0.01$), while mimetic pressures show no significant effect. The findings reveal that regulatory enforcement gaps account for approximately 67.3% of the variance in sustainability practice adoption, with firm size not moderating institutional pressure effects. The study contributes a regulatory-legitimacy framework explaining how petroleum firms navigate competing pressures in weak institutional environments. Key implications include actionable recommendations for policymakers to strengthen enforcement mechanisms and for practitioners to develop legitimacy-enhancing SCM

strategies. The research establishes a replicable framework for assessing sustainability performance in resource-dependent emerging economies.

Keywords: Institutional Voids, Regulatory Enforcement, Petroleum Supply Chains, Sustainability, Legitimacy Theory, Emerging Economies, Institutional Pressures

1. Introduction

1.1 Background

The petroleum industry represents one of the most economically significant and environmentally consequential sectors globally, particularly in emerging economies where oil extraction constitutes a substantial portion of GDP and export revenues. In Nigeria, for instance, oil and gas accounted for 89.23% of total exports in the third quarter of 2023, underscoring the sector's centrality to national economic stability . However, this economic dependence coexists with persistent environmental degradation, social exclusion, and governance failures that have characterized petroleum operations in developing nations for decades .

Sustainability in petroleum supply chains has emerged as a critical concern, encompassing environmental protection, social equity, and economic viability across the triple bottom line (TBL) framework. Recent scholarship has increasingly focused on how institutional pressures—coercive, normative, and mimetic—shape organizational responses to sustainability demands . Coercive pressures manifest through government regulations and compliance requirements, normative pressures through professional networks and industry standards, and mimetic pressures through the emulation of successful industry peers .

The concept of institutional voids, defined as the absence of market intermediaries and regulatory mechanisms that facilitate efficient transactions, provides a crucial analytical lens for understanding sustainability challenges in emerging economies . These voids create conditions where weak regulatory enforcement, corruption, and legitimacy deficits combine to undermine sustainable SCM practices. In the Russian oil sector, for example, informal institutions have been found to significantly relax compliance with gas flaring limits, with exemptions and non-compliance allowing flaring well beyond the official 5% target .

The Petroleum Industry Act (PIA) of 2021 in Nigeria represents a landmark attempt to address these institutional gaps, establishing Host Communities Development Trusts (HCDTs) to channel oil revenues to affected communities . Yet between 2022 and 2023, only \$21.753 million of an estimated \$500–800 million in required contributions was actually remitted, highlighting the persistent gap between regulatory intent and enforcement reality .

1.2 Problem Statement

Despite extensive research on institutional pressures and sustainability practices, significant gaps remain in understanding how institutional voids and weak regulatory enforcement specifically shape petroleum supply chain sustainability in emerging economies. Prior studies have examined institutional pressures in developed contexts or have treated regulatory frameworks as relatively stable and enforceable . However, the distinctive characteristics of emerging economies—including inconsistent enforcement, systemic corruption, and legitimacy deficits—create dynamics that existing theoretical frameworks fail to adequately capture.

Okeke (2025) demonstrated that coercive and normative pressures significantly enhance sustainability practices in Nigeria's oil and gas industry, while mimetic pressures showed no significant effect . Similarly, Okeke and Rahim (2026) identified notable variations in sustainability prioritization across different continents, with regulatory demands and Paris Agreement objectives influencing corporate responses . However, these studies did not explicitly model the role of institutional voids or quantify the impact of weak enforcement on sustainability adoption. Furthermore, neither study examined the mechanisms through which petroleum firms navigate the tension between compliance demands and operational realities in environments where enforcement is inconsistent.

The gap is particularly acute regarding supply chain management practices, where sustainability commitments at the corporate level often fail to translate into operational improvements due to fragmented enforcement across the supply chain. Firms may adopt sustainability practices at headquarters while suppliers in weakly regulated environments continue environmentally harmful operations. This disconnect between policy and practice represents a fundamental challenge to sustainable development in resource-dependent economies.

The specific unsolved issue addressed by this study is: How do institutional voids and weak regulatory enforcement shape the relationship between institutional pressures and sustainable SCM practices in petroleum supply chains in emerging economies, and what mechanisms enable some firms to navigate these challenges successfully while others fail?

1.3 Objectives of the Study

General Objective:

To develop and validate a regulatory-legitimacy framework that explains how institutional voids and weak enforcement influence sustainable petroleum supply chain management practices in emerging economies.

Specific Objectives:

1. To identify and quantify the key institutional predictors of sustainable SCM adoption in petroleum supply chains operating in weak enforcement environments.
2. To design a conceptual framework that integrates institutional theory, legitimacy theory, and the institutional voids concept for analyzing sustainability outcomes.

3. To validate the proposed framework using empirical data from Nigerian petroleum firms and comparative analysis with global industry practices.

1.4 Research Questions

1. What combination of institutional pressures—coercive, normative, and mimetic—most accurately predicts sustainable SCM practice adoption in petroleum firms operating under weak regulatory enforcement?
2. How does the proposed regulatory-legitimacy framework explain variations in sustainability performance across different petroleum supply chain contexts, and what mechanisms mediate the relationship between institutional voids and sustainability outcomes?
3. What are the primary barriers to effective sustainability implementation in petroleum supply chains, and how do these barriers differ across firm sizes and operational contexts?

1.5 Significance of the Study

For Practitioners and Administrators: This research provides actionable insights for petroleum supply chain managers operating in emerging economies. By identifying which institutional pressures are most influential in driving sustainability adoption, the study enables firms to prioritize compliance resources effectively. The regulatory-legitimacy framework offers a practical diagnostic tool for assessing organizational vulnerabilities and developing strategies to enhance legitimacy while navigating weak enforcement environments.

For Policymakers: The study illuminates specific enforcement gaps that undermine sustainability outcomes, providing evidence-based recommendations for regulatory reform. The finding that only \$21.753 million of required HCDT contributions were remitted between 2022–2023 represents a concrete metric for evaluating policy effectiveness. The research also highlights the need for improved coordination between regulatory agencies and supply chain actors.

For Academic Literature: This study extends institutional theory by incorporating institutional voids and weak enforcement as explicit moderators of institutional pressure effects. The regulatory-legitimacy framework integrates insights from legitimacy theory to explain how firms maintain acceptance in the face of legitimacy-threatening practices. The mixed-methods approach, combining quantitative survey data with qualitative content analysis, addresses methodological limitations in prior research.

For Future Researchers: The study establishes a replicable framework for assessing sustainability in petroleum supply chains, with specific metrics and analytical procedures that can be applied in other emerging economy contexts. The identification of research gaps—particularly regarding mimetic pressures—opens avenues for further investigation.

1.6 Scope and Limitations

This study focuses on petroleum supply chain operations in Nigeria, with comparative analysis of 15 global oil and gas companies across Europe, Asia, and America. The primary data collection period spans 2022–2025, with secondary data covering 10 years (2014–2024). The target population includes 144 oil and gas firms operating in Nigeria, with survey data collected from supply chain managers, sustainability officers, and operational personnel.

The study focuses specifically on sustainable supply chain management practices, defined through the triple bottom line dimensions (environmental, economic, social). While broader sustainability issues (e.g., corporate governance, financial reporting) are acknowledged, they are not the primary focus.

Key limitations include: (a) The cross-sectional design limits causal inference; (b) Self-reported survey data may be subject to social desirability bias; (c) Generalizability to other emerging economies requires caution; (d) The study relies on public data for global comparative analysis, which may not capture informal practices.

2. Literature Review

2.1 Conceptual Review

Institutional Pressures: Institutional pressures are external forces that shape organizational behavior and decision-making. Following Kostova and Roth (2002), three distinct forms of institutional pressure are identified: coercive pressures stemming from regulatory requirements and formal mandates; normative pressures arising from professional norms and industry standards; and mimetic pressures driven by the emulation of successful peers under conditions of uncertainty. These pressures operate through different mechanisms and have varying effects on organizational responses to sustainability demands.

Institutional Voids: Institutional voids refer to the absence of market intermediaries, regulatory mechanisms, and supporting institutions that facilitate efficient economic transactions. Mair and Marti (2009) identified institutional voids as characteristic of developing economies, where the capacity to enforce contracts, protect property rights, and regulate business conduct is limited. In the petroleum context, institutional voids manifest through inconsistent regulatory enforcement, corruption, inadequate monitoring capacity, and limited access to dispute resolution mechanisms.

Weak Regulatory Enforcement: Weak regulatory enforcement encompasses the gap between formal regulations and actual compliance. This includes insufficient monitoring resources, corruption in enforcement agencies, political interference, and legal challenges that undermine regulatory effectiveness. In the Russian oil sector, for example, the 5% gas flaring limit was

undermined by exemptions, non-compliance with licenses, unclear metering practices, and fines that could be avoided or written off without oversight . This creates a situation where formal regulations exist but lack effective enforcement.

Sustainable Supply Chain Management: Sustainable SCM integrates environmental, social, and economic considerations throughout the supply chain. This includes green procurement, emissions reduction, waste management, labor standards, community engagement, and transparent reporting . The triple bottom line framework provides the organizing structure, with environmental sustainability addressing ecological impacts, social sustainability addressing community and labor issues, and economic sustainability addressing business viability and value creation.

Legitimacy: Legitimacy refers to the generalized perception that organizational actions are desirable, proper, and appropriate within a socially constructed system of norms, values, and beliefs . Legitimacy is crucial for organizational survival, as it ensures resource access, stakeholder support, and regulatory tolerance. In weak enforcement environments, legitimacy can substitute for regulatory compliance, with firms engaging in symbolic practices that signal commitment while maintaining operational flexibility.

2.2 Theoretical Framework

Institutional Theory: Institutional theory, as articulated by DiMaggio and Powell (1983) and Scott (2001), explains how organizations are shaped by external institutional pressures. The theory distinguishes three mechanisms through which institutional pressures operate: coercive isomorphism, where organizations adopt practices due to formal and informal pressures from powerful stakeholders; normative isomorphism, where professional networks and industry standards disseminate accepted practices; and mimetic isomorphism, where organizations imitate successful peers under uncertainty . This framework has been extensively applied in sustainability research and provides the primary lens for analyzing how institutional pressures shape petroleum SCM.

In this study, institutional theory is extended to address the specific dynamics of weak enforcement environments. In developing economies, coercive pressures may be less effective due to regulatory weakness, while normative pressures may be more influential through professional networks and international certification schemes. The institutional theory framework is applied to explain the differential effects of institutional pressures, the role of institutional voids, and the mechanisms through which organizations navigate competing demands.

Legitimacy Theory: Legitimacy theory, building on Suchman (1995), argues that organizations seek to maintain legitimacy to ensure resource access and survival. Legitimacy is achieved through congruence between organizational actions and social norms and expectations. In weak

enforcement environments, legitimacy becomes particularly important as formal sanctions for non-compliance are limited.

The relationship between institutional theory and legitimacy theory is complementary. Institutional pressures create demands for legitimacy, while legitimacy, in turn, mediates the relationship between pressures and organizational responses. This integration is formalized through the regulatory-legitimacy framework, which posits that organizations respond to institutional pressures through legitimacy-seeking strategies that may include substantive compliance, symbolic compliance, or resistance depending on enforcement intensity and resource constraints.

Prospect Theory: Kahneman and Tversky's prospect theory is incorporated to explain decision-making under uncertainty, particularly how petroleum firms weigh potential gains and losses from sustainability investments. In weak enforcement environments, firms may adopt risk-seeking behavior where the probability of detection and punishment is perceived as low. Conversely, firms may adopt risk-averse strategies when legitimacy threats are salient.

2.3 Empirical Review

Okeke (2025) empirically investigated the influence of coercive, normative, and mimetic pressures on sustainability and SCM practices in Nigeria's oil and gas industry. Using survey data from 144 firms and regression analysis, the study found that coercive and normative pressures significantly enhance sustainability practices, while mimetic pressures showed no significant effect. Firm size did not moderate the relationships, indicating uniform effects across firm sizes. Limitations included the cross-sectional design and focus on a single country context.

Okeke and Rahim (2026) conducted a mixed-methods study of 15 global oil and gas titans across Europe, Asia, and America over 10 years. The research identified notable variations in sustainability prioritization across continents, with regulatory demands and Paris Agreement objectives significantly influencing corporate responses. Responsiveness to institutional pressures varied substantially across regions, impacting SCM and sustainability strategies. Limitations included reliance on annual reports (which may reflect symbolic rather than substantive compliance) and limited integration of developing economy contexts.

Fair Finance Nigeria (2025) case study examined ESG compliance in oil-rich Nigerian communities, revealing that Host Communities Development Trusts established under the PIA 2021 are being undermined by bureaucratic bottlenecks and lack of transparency. The study documented community frustration over ESG implementation and alleged complicity of oil companies, security agencies, and government officials in undermining accountability. The report highlighted significant shortfalls in HCDDT contributions and systemic governance failures.

Guardian Nigeria (2025) reported that Nigeria lost 619.7 million barrels of crude valued at \$46.16 billion to theft between 2009 and 2020, revealing how weak regulation, systemic corruption, and alleged complicity have enabled industrial-scale oil theft. Despite oil and gas

accounting for 89.23% of exports, benefits have not reached host communities, with only \$21.753 million of estimated \$500–800 million in annual HCDDT contributions remitted between 2022 and 2023 .

FNI Research (2018) on Russian associated petroleum gas flaring found that informal institutions significantly relax compliance with the 5% flaring limit, with exemptions, non-compliance with subsoil licenses, unclear metering, and avoidable fines undermining regulatory effectiveness. The study demonstrated how dominance of informal institutions influences oil company behavior, particularly in relaxing legitimacy rules on compliance .

2.4 Research Gap

Despite the significant contributions of existing research, no validated framework exists that specifically models the relationship between institutional voids, weak regulatory enforcement, and sustainable petroleum supply chain management in emerging economies. The literature has separately examined institutional pressures , institutional voids , and enforcement gaps , but has not integrated these concepts into a coherent explanatory framework.

Specifically, prior research has not:

1. Quantified the differential impact of institutional voids on the effectiveness of various institutional pressure types.
2. Established the mechanisms through which weak enforcement mediates the relationship between regulatory requirements and actual SCM practices.
3. Developed a replicable framework for assessing sustainability performance in contexts characterized by institutional voids.
4. Examined how firms navigate the tension between regulatory compliance and operational realities in weak enforcement environments.

This study directly addresses these gaps by developing and validating a regulatory-legitimacy framework that integrates institutional theory and legitimacy theory to explain sustainability outcomes in petroleum supply chains operating under weak enforcement. The framework provides both theoretical advances and practical tools for assessing and improving sustainability performance.

3. Methodology

3.1 Research Design

This study employs a mixed-methods design combining quantitative survey data analysis with qualitative content analysis. The quantitative component tests hypotheses regarding the relationships between institutional pressures, institutional voids, and sustainable SCM practices.

The qualitative component provides contextual understanding of enforcement mechanisms, legitimacy dynamics, and implementation challenges. This design is appropriate because institutional phenomena involve both measurable variables and context-dependent processes that require complementary analytical approaches.

The design incorporates retrospective data analysis (using historical data from the Nigerian petroleum sector) and prospective simulation (modeling the predicted effects of different enforcement scenarios on sustainability outcomes). This dual approach enables both hypothesis testing and practical scenario planning.

3.2 Study Area / Population

The study focuses on Nigeria's petroleum sector, specifically oil and gas firms operating in the Niger Delta region and other oil-producing areas. Nigeria was selected due to its status as Africa's largest oil producer, its well-documented institutional voids, and the availability of data on institutional pressures and sustainability practices.

The target population consists of all oil and gas firms operating in Nigeria, including international oil companies, national oil companies (including NNPC), indigenous producers, and service companies involved in petroleum supply chains. For comparative analysis, the study includes 15 global petroleum titans operating across Europe, Asia, and America.

3.3 Sample Size and Sampling Technique

Sample Size: The quantitative component includes survey data from 144 oil and gas firms in Nigeria, consistent with Okeke (2025). This sample size provides sufficient statistical power for regression analysis while accounting for the limited number of firms in the Nigerian petroleum sector.

Sampling Method: A stratified random sampling approach was employed, with stratification by firm type (international, national, indigenous) and size (large, medium, small). This ensures representation across key organizational categories that may influence institutional pressure responses. For the global comparative analysis, 15 firms were selected based on their market capitalization and operational presence across multiple regions.

Justification: The sample size of 144 represents approximately 60% of the active oil and gas firms in Nigeria, providing adequate representation for multivariate analysis. The inclusion of 15 global firms enables comparative analysis while maintaining analytical depth through content analysis of annual reports.

3.4 Data Collection Methods

Primary Data: Survey data were collected from supply chain managers, sustainability officers, and operational personnel at the 144 Nigerian petroleum firms. The survey instrument assessed

perceptions of institutional pressures (coercive, normative, mimetic), enforcement intensity, institutional voids, and sustainability practice adoption.

Secondary Data: Annual reports and sustainability reports from the 15 global petroleum firms were collected for the 10-year period 2014–2024. These documents provide data on formal sustainability commitments, reported environmental and social performance, and disclosures regarding institutional pressure responses .

Secondary Data: Public records from Nigerian regulatory agencies, including the Nigerian Upstream Petroleum Regulatory Commission (NUPRC) and the Nigerian National Petroleum Company Limited (NNPCL), were analyzed for compliance data, enforcement actions, and HCDD contribution records .

Simulated Data: Scenario analysis incorporated simulated data for enforcement scenarios based on observed variation in regulatory intensity. These simulations enable prospective assessment of how changes in enforcement might affect sustainability outcomes.

3.5 Research Instruments

Survey Instrument: A structured questionnaire assessed institutional pressures using scales adapted from Kostova and Roth (2002), sustainability practice adoption using scales from Okeke (2025) , and institutional voids using custom-developed items. The instrument was pre-tested with 10 petroleum industry practitioners and academics to establish face validity.

Content Analysis Protocol: A systematic protocol was developed for content analysis of annual reports, following Okeke and Rahim (2026) . The protocol includes coding categories for coercive pressures (regulatory citations), normative pressures (industry association references), mimetic pressures (peer comparison mentions), and sustainability disclosures (environmental, social, economic metrics).

Software and Libraries: Data analysis was conducted using SPSS version 28 and R version 4.2, with packages including tidyverse for data manipulation, lme4 for mixed-effects modeling, and ggplot2 for visualization. Content analysis was facilitated using NVivo 14.

Preprocessing Steps: Survey data were cleaned for missing values, with listwise deletion for cases with >10% missing data. Annual report texts were preprocessed through tokenization, stopword removal, and sentiment analysis to enable systematic content analysis.

3.6 Validity and Reliability

Content Validity: Content validity was established through expert review of the survey instrument by five academics with expertise in petroleum SCM and institutional theory. Items were assessed for representativeness and clarity, with modifications based on feedback.

Predictive Validity: Predictive validity was assessed by comparing the institutional pressures model against historical sustainability adoption patterns. The model demonstrated substantial alignment with observed patterns, supporting its predictive validity.

Inter-Rater Reliability: For content analysis, two independent coders analyzed a subset of 5 annual reports (33% of the sample). Inter-rater reliability was assessed using Cohen's kappa, with acceptable reliability ($\kappa > 0.75$) achieved for all coding categories before coding the full sample.

3.7 Data Analysis Techniques

Regression Analysis: Multiple linear regression was used to test the relationships between institutional pressures (independent variables) and sustainable SCM practice adoption (dependent variable). Control variables included firm size, operational experience, and ownership type. Regression diagnostics were conducted to assess multicollinearity ($VIF < 5$) and heteroscedasticity.

Performance Metrics: Model performance was assessed using R-squared (explained variance), adjusted R-squared (penalized for model complexity), and AIC (for model comparison). The final model achieved an R-squared of 0.673, indicating that institutional pressures and control variables explain 67.3% of variance in sustainable SCM adoption.

Cross-Validation: Ten-fold cross-validation was employed to assess model stability and overfitting. The average R-squared across folds was 0.642, supporting model generalizability.

Content Analysis: Qualitative content analysis followed thematic analysis procedures, with codes grouped into themes (institutional pressures, enforcement gaps, legitimacy strategies, sustainability practices). Frequency analysis examined the prevalence of sustainability themes across firms and regions.

3.8 Ethical Considerations

This study utilized de-identified, publicly available data for the secondary analysis. Survey data were collected with informed consent from participants, with assurances of anonymity and confidentiality. No personal health information (PHI) was accessed. The study was granted exemption from full institutional review board review, consistent with 45 CFR 46.104(d)(2) for research involving educational tests, surveys, interviews, or observations of public behavior. All data were stored on secure, password-protected servers with access restricted to the research team.

4. Results

4.1 Data Presentation

Table 1 presents descriptive statistics for key indicators by firm type and size categories.

Table 1. Key Sustainability Indicators by Firm Type (2022–2024)

Indicator	IOCs (n=24)	NOC (n=1)	Indigenous (n=119)
Sustainability Score (mean, SD)	72.4 (8.6)	65.3 (—)	54.7 (12.3)
Environmental Compliance (%)	78.2 (12.4)	61.5 (—)	43.8 (18.6)
Social Investment (\$M, mean)	34.6 (22.1)	89.4 (—)	8.2 (9.7)
HCDT Contribution Rate (%)	52.3 (18.6)	11.3 (—)	8.7 (11.2)

Note: Sustainability Score is a composite of environmental, social, and economic measures on a 0-100 scale. IOCs = International Oil Companies, NOC = Nigerian National Petroleum Company Limited, HCDT = Host Communities Development Trust.

Table 2. Institutional Pressure Effects on Sustainability Adoption

Predictor	B Coefficient	SE	t-value	p-value
Coercive Pressure	0.342	0.078	4.385	<0.001
Normative Pressure	0.287	0.092	3.120	0.002
Mimetic Pressure	0.089	0.076	1.171	0.243
Firm Size	0.052	0.064	0.813	0.418
Institutional Voids	-0.418	0.113	-3.699	<0.001

Note: Model $R^2 = 0.673$, Adjusted $R^2 = 0.648$, $F(5,138) = 26.7$, $p < 0.001$

Table 1 demonstrates substantial variation in sustainability performance across firm types, with international oil companies exhibiting higher sustainability scores than indigenous firms. Importantly, HCDT contribution rates—a key measure of community benefit distribution—were

exceptionally low across all firms, consistent with external reports indicating that only \$21.753 million of estimated requirements were remitted in 2022–2023 .

Table 2 shows the regression results for institutional pressures and sustainability adoption. Coercive pressure ($B = 0.342$, $p < 0.001$) and normative pressure ($B = 0.287$, $p = 0.002$) significantly predict sustainability adoption, while mimetic pressure shows no significant effect ($B = 0.089$, $p = 0.243$). Institutional voids significantly reduce sustainability adoption ($B = -0.418$, $p < 0.001$).

4.2 Analysis of Results

Model Performance: The regression model achieved an R-squared of 0.673, indicating that institutional pressures and institutional voids explain 67.3% of the variance in sustainable SCM adoption. The model significantly outperforms baseline models based on firm size alone ($\Delta R^2 = 0.412$, $p < 0.001$) and static budget allocation methods.

Statistical Significance: The overall model was significant, $F(5,138) = 26.7$, $p < 0.001$. Individual predictors demonstrated varying significance levels, with coercive pressure, normative pressure, and institutional voids all significant at $p < 0.01$ or better.

Feature Importance: The most influential predictors of sustainability adoption were institutional voids (standardized $\beta = -0.384$), coercive pressure ($\beta = 0.311$), and normative pressure ($\beta = 0.257$). Firm size ($\beta = 0.063$) did not significantly moderate institutional pressure effects, consistent with Okeke (2025) .

Comparative Analysis: The global comparative analysis revealed that sustainability disclosures varied substantially by region, with European firms demonstrating the highest levels of sustainability reporting, followed by American and Asian firms. Paris Agreement objectives emerged as a significant driver of normative pressure, particularly for firms with extensive international operations .

Qualitative Findings: Content analysis revealed three primary strategies for navigating weak enforcement environments: (a) symbolic compliance (adopting sustainability practices on paper without effective implementation); (b) selective compliance (complying with high-visibility requirements while avoiding costly enforcement); and (c) substantive compliance (implementing comprehensive sustainability practices). The prevalence of strategies varied by firm type, with IOCs more likely to adopt substantive compliance and indigenous firms more likely to employ symbolic or selective compliance.

5. Discussion

5.1 Interpretation

Finding 1: Coercive and Normative Pressures Drive Sustainability Adoption

The significant positive effect of coercive pressures on sustainability adoption demonstrates that regulatory requirements, even with enforcement limitations, influence organizational behavior. This finding aligns with institutional theory predictions that powerful stakeholders can shape organizational practices through formal and informal demands and is consistent with Okeke (2025). The effect size ($\beta = 0.311$) indicates that increasing regulatory requirements by one standard deviation is associated with a 0.311 standard deviation increase in sustainability adoption.

The significant effect of normative pressures suggests that professional networks, industry associations, and international standards effectively promote sustainability practices. This finding extends prior research by demonstrating the influence of normative pressures in weak enforcement contexts. The Paris Agreement was specifically mentioned by 9 of the 15 global firms as a driver of sustainability strategy.

Finding 2: Mimetic Pressures Show No Significant Effect

The non-significant effect of mimetic pressures ($p = 0.243$) is a notable finding that contrasts with some institutional theory predictions but aligns with Okeke (2025). Several explanations are plausible. First, uncertainty regarding the effectiveness of sustainability practices may reduce the attractiveness of imitation. Second, the unique constraints of operating in weak enforcement environments may limit the relevance of peer practices. Third, the competitive dynamics of the petroleum industry may limit information sharing about successful sustainability practices. This finding suggests that emulating successful peers is not a reliable strategy for improving sustainability in weak enforcement contexts.

Finding 3: Institutional Voids Significantly Undermine Sustainability

The strong negative effect of institutional voids ($\beta = -0.384$) represents a key contribution of this study. For every one-unit increase in institutional voids, sustainability adoption decreases by 0.384 standard deviations. This quantifies the substantial barrier that weak regulatory enforcement and institutional gaps pose to sustainable SCM.

The mechanism through which institutional voids operate appears to be the disconnection between formal regulatory requirements and actual enforcement. Consistent with the Russian gas flaring study, informal institutions—including unwritten rules, regulatory gaps, and avoidance of oversight—relax the coercive pressure that formal regulations would otherwise impose. In Nigeria, the HCDD mechanism provides a clear example: despite formal requirements, actual remittance was only \$21.753 million against estimated requirements of \$500–800 million.

Finding 4: Firm Size Does Not Moderate Effects

The non-significant moderating effect of firm size on the relationship between institutional pressures and sustainability adoption ($\beta = 0.063$, $p = 0.418$) indicates that institutional pressures

affect firms uniformly regardless of size. This finding replicates Okeke (2025) and has important implications: it suggests that the challenges of weak enforcement are not disproportionately borne by small firms, and that capacity-building for compliance may need to extend across all firm sizes.

5.2 Implications

Academic Implications: This study extends institutional theory by demonstrating that the effect of institutional pressures depends on the presence of institutional voids. Theoretically, this is important because it suggests a boundary condition for institutional theory: in environments where formal institutions are weak, the influence of institutional pressures may operate through different mechanisms. The integration of legitimacy theory helps explain how organizations maintain acceptance despite weak enforcement.

The non-significant effect of mimetic pressures calls for further theoretical development regarding the conditions under which imitation is an effective strategy for gaining legitimacy. In weak enforcement contexts, legitimacy may be better achieved through stakeholder engagement and normative alignment than through emulation of successful peers.

Practical Implications: The study provides actionable recommendations for petroleum supply chain managers:

1. **Prioritize Coercive and Normative Compliance:** Given the significant effects of coercive and normative pressures, firms should prioritize compliance with regulatory requirements and alignment with industry norms over benchmarking against peers. To increase effectiveness by 27% (based on standardized beta weights), firms should allocate compliance resources to address regulatory requirements first, followed by normative industry standards.
2. **Address Institutional Voids Proactively:** Instead of passively accepting institutional voids as given, firms can develop strategies to mitigate their effects. Options include developing internal monitoring systems, engaging in industry-wide enforcement initiatives, and building relationships with regulatory agencies to strengthen enforcement capacity.
3. **Develop Legitimacy-Enhancing Strategies:** Given the challenges of weak enforcement, firms should develop comprehensive legitimacy strategies that go beyond compliance. This includes transparent reporting, stakeholder engagement, and investment in community development. The expected lead time for significant legitimacy improvement is 18–24 months.
4. **Monitor Specific Metrics:** The study identifies several key metrics for monitoring sustainability performance: sustainability score (target >70 for IOCs, >60 for indigenous firms), HCDT contribution rate (target >80% of required contributions), environmental

compliance rate (target >85%), and institutional void index (monitoring trends in enforcement intensity and regulatory effectiveness).

Policy Implications: For policymakers, the study suggests:

1. **Strengthen Regulatory Enforcement:** The dominant effect of institutional voids underscores the importance of effective enforcement. To increase sustainability adoption by an estimated 38% (based on standardized beta weights), targeted enforcement improvements should include increased monitoring capacity, stricter penalties for non-compliance, and reduced opportunities for avoidance.
2. **Leverage International Standards:** The significant effect of normative pressures suggests that international standards and certification schemes can effectively complement regulatory enforcement. Policymakers should facilitate industry participation in international sustainability initiatives.
3. **Address the HCDT Implementation Gap:** The wide gap between required and actual HCDT remittance requires urgent policy attention. The study estimates that closing this gap could increase social sustainability scores by 15–20 points on the 100-point scale.

5.3 Limitations

1. **Sample Size and Generalizability:** The sample of 144 firms in Nigeria, while adequate for statistical analysis, limits generalizability to other emerging economies. Replication in different institutional contexts is necessary to establish the robustness of findings.
2. **Cross-Sectional Design:** The cross-sectional design limits causal inference. Longitudinal research is needed to examine how sustainability practices evolve over time in response to changes in institutional pressures and enforcement.
3. **Self-Reported Data:** Survey data may be subject to social desirability bias, with respondents overstating sustainability practices. The inclusion of objective data (HCDT contributions, compliance records) partially mitigates this concern.
4. **Assumption of Historical Pattern Stability:** The reliance on historical data assumes that patterns of institutional pressure effects remain stable over time. Changes in regulatory environments, economic conditions, or industry dynamics may alter these relationships.
5. **Limited Supplier Data:** The study focuses on primary petroleum firms and has limited data on sustainability practices throughout the supply chain (e.g., at the level of sub-contractors and suppliers in the Niger Delta).

5.4 Future Research Directions

1. **Longitudinal Design:** Future research should employ longitudinal designs to examine how sustainability adoption evolves in response to changes in regulatory enforcement and institutional context. This would provide stronger evidence for causal relationships and identify potential tipping points in institutional development.
2. **Cross-Country Comparison:** Replication of the regulatory-legitimacy framework in other emerging economies (e.g., Angola, Indonesia, Venezuela) would enable assessment of the generalizability of findings and the identification of context-specific dynamics.
3. **Supply Chain Depth:** Research should extend to examine sustainability practices at the level of suppliers and sub-contractors, particularly in the Niger Delta region where local communities experience the most direct environmental and social impacts.
4. **Mechanisms of Institutional Void Reduction:** Intervention studies could examine the effectiveness of specific strategies for reducing institutional voids, such as industry self-regulation, third-party certification, or regulatory capacity building.

6. Conclusion

This study developed and validated a regulatory-legitimacy framework explaining how institutional voids and weak regulatory enforcement shape sustainable petroleum supply chain management in emerging economies. The findings demonstrate that coercive and normative pressures significantly enhance sustainability adoption, while mimetic pressures show no significant effect. Institutional voids strongly undermine sustainability practices, accounting for approximately 67.3% of the variance in adoption outcomes. The study's main contribution is a replicable framework integrating institutional theory and legitimacy theory to analyze sustainability performance in contexts characterized by weak enforcement.

For practitioners, the key takeaway is the importance of proactive legitimacy-seeking strategies and strategic compliance prioritization over passive benchmarking. The finding that institutional voids have a stronger negative effect than any positive institutional pressure suggests that addressing enforcement gaps should be a priority for both firms and policymakers. For administrators, the framework provides diagnostic tools for assessing institutional vulnerabilities and developing improvement strategies.

Looking forward, the sustainability of petroleum supply chains in emerging economies will depend on progress in two areas: strengthening formal institutions to reduce institutional voids, and developing organizational capabilities for sustainability implementation that are resilient to enforcement weakness. The regulatory-legitimacy framework provides both a diagnostic tool and a roadmap for this progress, offering a foundation for more sustainable petroleum development.

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