

The Impact of Tax Administration Modernization and Governance on Tax Compliance and Revenue Sustainability in Extractive Industries: An Analytical Review of Global Trends (2020-2025)

MAYOU Abd Ellah¹, BOUGOFFA Abdelheg^{2 *}, ARABA Elhadj

¹ University of Ouargla (Algeria) , mayouabdellah@gmail.com

² University of Ouargla (Algeria) , bougoffa1@gmail.com

³ University of Ouargla (Algeria) , araba.hadj@gmail.com

Received: 21/04/2026

Accepted: 22/05/2026

Published: 30/06/2026

Abstract:

This study investigates the impact of two primary independent variables - tax administration modernization and governance frameworks- on the dependent variables of tax compliance and revenue sustainability within the global extractive industries from 2020 to 2025. As resource-rich nations navigate the complexities of the post-pandemic economic landscape and the global energy transition, the digitalization of tax systems—incorporating Artificial Intelligence (AI), Blockchain, and Big Data—has emerged as a pivotal factor in enhancing fiscal capacity (Abdullah & Almaqtari, 2024). By providing an exploratory and analytical reading of authoritative institutional reports and scholarly literature, this research analyzes how modern legal designs and institutional reforms mitigate corruption risks and improve transparency, thereby fostering higher levels of taxpayer compliance (World Bank, 2020; Sofrona et al., 2025). The findings suggest that revenue sustainability is not merely a function of tax rates but is deeply rooted in 'universalization reasoning' and the moral internalization of compliance linked to the perceived effectiveness of public spending (Muñoz-Sobrado, 2025). Ultimately, the study identifies that a robust nexus between technological adoption and strong governance is essential for securing long-term domestic resource mobilization and achieving the Sustainable Development Goals (SDGs) (OECD, 2025; United Nations, 2021).

Keyword: Tax Administration; Governance; Extractive Industries; Revenue Sustainability; Digital Transformation; Fiscal Capacity; Corruption.

JEL Classification Codes: G18; H2; M11.

1. Introduction

1.1 The Global Fiscal Landscape in Extractive Industries

The global economic landscape for extractive industries has undergone a seismic shift between 2020 and 2025. This period, characterized by the dual pressures of post-pandemic recovery and an accelerating global energy transition, has forced resource-rich nations to re-evaluate their fiscal architectures. Traditionally, the stability of these nations depended on the sheer volume of resource exports; however, the modern era demands a shift toward "Fiscal Capacity" and "Administrative Modernization." As noted in the **OECD (2025)** Global Outlook, the resilience of domestic resource mobilization is no longer a secondary concern but a primary pillar of national sovereignty. The extractive sector, historically prone to opacity and elite capture, now stands at a crossroads where technological innovation and governance reform must converge to ensure long-term revenue sustainability.

The volatility of commodity prices, coupled with the increasing complexity of international tax avoidance strategies, has rendered traditional tax administration methods obsolete. In this context, "Modernization" is not merely a technical upgrade but a strategic necessity. The integration of Industry 4.0 technologies—such as Artificial Intelligence (AI), Blockchain, and Big Data—into tax procedures is transforming how states monitor resource flows and audit multinational corporations. As **Abdullah & Almaqtari (2024)** argue, this digital leap is redefining the very essence of accounting and auditing, moving from retrospective verification to real-time, predictive compliance.

1.2 The Nexus of Governance, Technology, and Compliance

The central problem facing tax authorities in the extractive sector is the "Compliance Gap." This gap is often exacerbated by weak governance structures that allow for corruption and revenue leakage. Current discourse, supported by **IMF (2025)** working papers, suggests that the "Legal Design" of tax systems is as critical as the technology used to manage them. Strengthening tax governance is not only about catching tax evaders but about building a "Moral Contract" between the state and the taxpayer. This leads to the concept of "Universalization Reasoning," a theoretical framework explored by **Muñoz-Sobrado (2025)**, which suggests that fiscal capacity is deeply rooted in the perceived fairness and effectiveness of public spending.

When taxpayers—especially large-scale operators in the extractive sector—perceive that the tax administration is modernized, transparent, and free from discretionary interference, their intrinsic motivation to comply increases. This "Moral Internalization" of tax compliance is the holy grail of

revenue sustainability. However, achieving this requires a sophisticated "Nexus Model" where administrative efficiency, robust legal frameworks, and digital transparency work in tandem. The "disinfecting effect of sunlight"—a metaphor for transparency often cited in governance literature—is now being operationalized through blockchain-based tracking of resource royalties and AI-driven risk assessment models (Septarini & Ismanto, 2024).

1.3 Research Objectives and Problem Statement

The primary objective of this study is to analyze the intricate interdependence between tax administration modernization, governance quality, and revenue sustainability within the extractive industries. While much has been written about digitalization in general, there is a significant scholarly gap in understanding how specific institutional recommendations from global bodies (like the IMF and World Bank) translate into sustainable fiscal outcomes in high-stakes environments like the mining and petroleum sectors.

Specifically, this study seeks to answer:

- ✓ How does the adoption of Industry 4.0 technologies (AI and Blockchain) redefine the "Fiscal Capacity" of resource-rich states?
- ✓ To what extent does "Legal Design" and governance reform mitigate the risks of elite capture and corruption in tax administration?
- ✓ What is the role of "Universalization Reasoning" in bridging the gap between technical modernization and long-term revenue sustainability?

By addressing these questions, the study aims to provide a comprehensive roadmap for policymakers navigating the complexities of the 2025 fiscal environment. It moves beyond the narrow focus on tax rates and instead emphasizes the "Systemic Integrity" of the tax ecosystem.

1.4 Research Hypotheses

Based on the synthesized global fiscal trends and the evolving digital landscape discussed above, this study proposes a set of hypotheses to be explored through its analytical framework:

- **Hypothesis 1 (H1):** The integration of Industry 4.0 technologies (AI and Blockchain) into tax administrations acts as a primary catalyst for redefining "Fiscal Capacity" by reducing information asymmetry and enhancing real-time auditing depth.
- **Hypothesis 2 (H2):** Robust "Legal Design" and governance reforms serve as essential structural vessels that mitigate the risks of elite

capture, thereby ensuring that technological modernization leads to actual revenue mobilization.

- **Hypothesis 3 (H3):** Tax compliance functions as a crucial mediating variable, where the perceived transparency and fairness of the modernized system foster "Universalization Reasoning," ultimately securing long-term revenue sustainability.

1.5 The Strategic Importance of Institutional Reports

A distinguishing feature of the current fiscal era is the dominant role played by international financial institutions in setting global standards. Reports from the **World Bank (2020)** and the **United Nations (2021)** have provided the blueprints for taxing extractive industries in developing nations. These reports are not merely advisory; they shape the "Legal Vessels" through which modernization is delivered. This study recognizes that the evolution of tax governance is a top-down process driven by global policy trends, which are then filtered through national institutional realities.

The focus on the 2020-2025 period is intentional. It represents a "Digital Frontier" where the theoretical promises of the last decade are finally being tested in real-world tax environments. As **Besseri & Saidi (2025)** highlight, the auditing profession is currently undergoing a fundamental transition, where the auditor's role is shifting from a "gatekeeper" to a "data analyst." This transition is particularly critical in the extractive sector, where the sheer volume of data can often mask illicit financial flows.

1.6 Scope and Methodological Clarification

To maintain clarity and academic focus, it is important to define the boundaries of this inquiry. **This study is constructed as an exploratory and analytical reading of authoritative institutional reports and selected scholarly literature, rather than a systematic review of all available metadata.** By prioritizing high-impact documents from organizations like the IMF, OECD, and UN, the study ensures that its findings are grounded in the most influential global policy trends. This approach allows for a more nuanced synthesis of how "Administrative Modernization" acts as a catalyst for "Governance Reform," which ultimately secures the mobilization of domestic resources.

The subsequent sections of this paper will delve into the technical dimensions of tax modernization, the behavioral economics of compliance, and the legal frameworks required to sustain revenue in an increasingly digital and transparent global economy. Through this multi-dimensional analysis, the study contributes to the growing body of knowledge on how resource-rich nations can achieve "Financial Sovereignty" in the mid-2020s.

2 Methodology

2.4 Philosophical and Methodological Orientation

The complexity of the fiscal landscape in extractive industries, particularly in the wake of the post-pandemic recovery and the global energy transition (2020-2025), necessitates a methodology that transcends simple data aggregation. This study adopts a **Qualitative Exploratory and Analytical Research Design**, centered on a comprehensive synthesis of institutional strategic directions and scholarly theoretical advancements. Rather than following a rigid, quantitative systematic mapping protocol such as PRISMA—which often prioritizes the volume of literature over the depth of policy impact—this methodology focuses on the "Analytical Reading" of high-level discourse.

The rationale for this approach lies in the unique nature of the subject matter. Tax administration in the extractive sector is governed more by international standards and strategic policy shifts than by static academic theories alone. As noted by **Abdullah & Almaqtari (2024)**, the rapid integration of Industry 4.0 technologies requires a flexible analytical framework to understand how these tools transform accounting and auditing practices. Therefore, an exploratory approach allows for a "Nexus-Based Analysis," where the researcher acts as an interpreter of global trends, linking the technical specifications of digital tools with the socio-political demands of governance and revenue sustainability.

2.5 Strategic Selection of Materials and Data Sources

The robustness of this study is rooted in the deliberate and strategic selection of its primary and secondary materials. Unlike traditional reviews that use broad keyword searches to find hundreds of papers, this study employs a "Purposive Selection" strategy to ensure high-level relevance.

• **Global Institutional and Policy Reports:** A substantial portion of the analytical weight is placed on the technical outputs of the world's leading financial and developmental organizations. **The selection of institutional reports was guided by their authoritative status in fiscal policy and their direct relevance to the extractive industries context.** This includes critical working papers from the **International Monetary Fund (IMF, 2025)** regarding tax governance through legal design, and strategic frameworks from the **OECD (2025)** concerning the global outlook on financing for sustainable development. Furthermore, the **United Nations (2021)** handbook on extractive industries provided the foundational criteria for assessing fiscal challenges in developing jurisdictions. These documents

are treated not merely as sources of data, but as the "Administrative Blueprints" currently shaping global fiscal capacity.

• **Scholarly Literature and Theoretical Integration:** To provide a rigorous academic backbone to the institutional findings, the study integrates cutting-edge research from specialized databases. The inclusion of works such as **Muñoz-Sobrado (2025)** is intended to bridge the gap between "Policy" and "Theory," specifically regarding the origins of fiscal capacity and "Universalization Reasoning." Additionally, the insights of **Besseri & Saidi (2025)** and **Septarini & Ismanto (2024)** provide the necessary granularity on the transition of the auditing profession toward Blockchain and AI-driven environments.

2.6 The Analytical Synthesis Process (The Triangulation Strategy)

The core of this methodology is the **Triangulation and Synthesis Strategy**, which allows for a multi-dimensional understanding of the research problem. The analysis was conducted through four distinct phases: Phase I: Contextual Scoping and Temporal Mapping (2020-2025)

The first phase involved a "Temporal Mapping" of the fiscal challenges emerging after 2020. This included analyzing how the COVID-19 pandemic acted as a catalyst for "Digital Urgency" in tax administrations. By reviewing the **UN (2021)** guidelines and **IMF (2025)** working papers, the study identified the shift from traditional tax collection to "Real-Time Digital Auditing" and "Compliance by Design."

Phase II: Thematic Categorization of Governance Frameworks

In this stage, the gathered reports and papers were categorized into three "Strategic Pillars" based on their contribution to the research objective:

➤ **The Technological Pillar:** Analyzing the integration of AI and Blockchain as discussed by **Abdullah & Almaqtari (2024)**.

➤ **The Governance and Legal Pillar:** Focusing on transparency and the mitigation of elite capture, drawing heavily from **Sofrona et al. (2025)** and the "Legal Design" models.

➤ **The Sustainability Pillar:** Evaluating long-term domestic resource mobilization as outlined in the **OECD (2025)** Global Outlook.

Phase III: Cross-Comparative Analysis

This phase involved "Comparative Synthesis," where the study compared the "Idealized Models" proposed by international organizations with the practical implementation challenges described in academic research. For instance, the study examined how the theoretical "disinfecting effect of sunlight" (transparency) mentioned in governance literature is practically enabled by the digital transformation technologies analyzed by **Septarini & Ismanto (2024)**.

Phase IV: The Construction of the "Nexus Model"

The final stage of the methodology involved the inductive construction of the "Nexus Model." By synthesizing evidence from both institutional reports and academic theories, the study formulated a holistic framework demonstrating that modernized tax administration and robust governance are deeply interdependent. This model explains how "Administrative Modernization" acts as a vessel for "Governance Reform," which in turn secures "Revenue Sustainability."

2.7 Inclusion Criteria and Geographic Focus

To maintain academic rigor, strict inclusion criteria were applied:

- **Temporal Relevance:** Only materials published between **January 2020 and October 2025** were considered to capture the "Digital Leap" in accounting and auditing.
- **Sectoral Specificity:** Materials had to directly address the "Extractive Industries" or provide "Cross-Sectoral Fiscal Theories" (like the universalization model by **Muñoz-Sobrado, 2025**) applicable to high-value resource sectors.
- **Authority and Impact:** For reports, the study prioritized organizations with a direct mandate for global financial stability (IMF, World Bank, OECD). For academic papers, the focus was on high-impact journals specializing in "Open Innovation" and "Digital Transformation."

2.8 Ethical Considerations and Methodological Limitations

The study acknowledges certain inherent limitations. As an exploratory reading of existing reports and literature, it does not involve primary empirical data collection. Therefore, the findings are subject to the quality and transparency of the data provided by the original reporting institutions. Furthermore, the rapid pace of technological evolution means that some AI applications discussed in **Septarini & Ismanto (2024)** are still in the pilot phase. However, by focusing on "Legal Design" (**Sofrona et al., 2025**) and "Theoretical Foundations," this methodology provides a durable framework for understanding the future of fiscal governance in the extractive sector.

3 Literature Review

3. Literature Review and Conceptual Framework

3.1. Technological Drivers: Industry 4.0 and Tax Modernization

The transition toward digital tax administration is no longer a theoretical preference but a functional imperative driven by the tools of Industry 4.0. A key insight from Abdullah & Almaqtari (2024) is that the integration of Artificial Intelligence (AI) and Big Data is fundamentally transforming accounting and auditing practices from retrospective checks to real-time oversight. This view is reinforced by Septarini & Ismanto (2024), who argue that the inevitability of accounting digitalization forces tax authorities to navigate complex technical challenges to maintain fiscal relevance.

Extending this logic, the adoption of Blockchain technology is presented by Besseri & Saidi (2025) as a transformative model for the auditing profession, offering an immutable ledger that enhances trust in resource-sector transactions. However, a limitation of this technological optimism is its heavy reliance on an advanced institutional capacity that many resource-rich states currently lack. While these digital drivers promise unprecedented efficiency, their applicability in low-income or fragile contexts remains an underexplored area that requires further empirical testing to move beyond pilot-phase success stories.

3.2. Governance Frameworks and the Transparency Effect

Modern governance in the extractive industries is increasingly centered on mitigating the risks of elite capture and systemic corruption. The IMF (2025) emphasizes that strengthening tax governance is primarily achieved through meticulous "Legal Design," which acts as a structural vessel for transparency. Central to this discourse is the "disinfecting effect of sunlight"—a principle where radical transparency in royalty flows and contract disclosure disrupts traditional corrupt networks.

The World Bank (2020) offers a complementary perspective, asserting that institutional reforms must go beyond mere policy papers to include enforceable oversight mechanisms. This transparency effect is not just a moral goal but a fiscal one; as Sofrona et al. (2025) observe, when legal frameworks are designed to minimize discretionary power, the opportunities for revenue leakage are significantly reduced. Nevertheless, the effectiveness of these "sunlight" policies is often hindered by political resistance, suggesting that the "Legal Design" must be coupled with strong political will to achieve meaningful reform.

3.3. Legal Design and Institutional Resilience

The structural integrity of tax systems depends on the robustness of their legal foundations. This perspective is championed by Sofrona,

Waerzeggers, & Crowley (2025), who argue that legal design is the primary tool for institutionalizing accountability within tax administrations. Contrasting with purely technical approaches, this legalistic view emphasizes that without clear statutory mandates, even the most advanced AI tools will fail to curb tax avoidance in the extractive sector.

This argument is further supported by the **United Nations (2021)** handbook, which provides a blueprint for developing nations to tax extractive industries effectively. The handbook suggests that the complexity of resource taxation requires specialized legal provisions that can withstand the aggressive tax planning of multinational corporations. While compelling, this reliance on legalism assumes a degree of judicial independence that is not always present in jurisdictions where extractive industries dominate the economy. Thus, the resilience of these institutions is often a byproduct of the broader "moral dimension of compliance" rather than legal enforcement alone.

3.4. Revenue Sustainability and the Moral Dimension

Revenue sustainability in the mid-2020s is being redefined as a balance between technical collection and perceived legitimacy. The **OECD (2025)** Global Outlook highlights that moving towards a more resilient and inclusive fiscal architecture requires addressing the widening financing gaps in sustainable development. A groundbreaking contribution to this debate is the concept of "universalization reasoning" introduced by **Muñoz-Sobrado (2025)**. This theory posits that fiscal capacity is deeply rooted in the origins of social cooperation, where taxpayers' willingness to comply is linked to the perceived universal benefit of public spending.

In this context, the moral dimension of compliance becomes a strategic asset. If the state demonstrates that extractive revenues are effectively channeled into public services, the "universalization" effect encourages voluntary compliance even among large-scale operators. This perspective shifts the focus from "deterrence" to "internalization." However, as many international reports acknowledge, bridging the gap between this theoretical moral contract and the practical reality of revenue mobilization remains the most significant challenge for resource-rich nations in the energy transition era.

3.5. Synthesizing the Nexus: Technology, Governance, and Sustainability

The synthesis of the aforementioned literature reveals a "Triple-Helix" relationship where no single factor can guarantee fiscal success in

isolation. The technological modernization discussed by **Abdullah & Almaqtari (2024)** provides the *tools*, the legal design advocated by the **IMF (2025)** provides the *vessel*, and the moral internalisation of compliance—or "universalization reasoning"—provides the *legitimacy*.

The **World Bank (2020)** and **UN (2021)** perspectives collectively suggest that for extractive industries, this nexus is particularly sensitive to global commodity cycles and international policy shifts. The core of this study's argument is that revenue sustainability emerges only when digital transparency (the transparency effect) is integrated into a governance framework that the public perceives as fair and effective. While the literature from 2020 to 2025 shows a clear trend toward digital and legal sophistication, the practical integration of these elements into a unified "Nexus Model" represents the next frontier for both academic research and policy implementation.

4 Conceptual Framework: The Integrated Nexus Model

To integrate the relationships identified in the preceding literature, this study develops an **Integrated Nexus Model** that explains the structural interaction between tax administration modernization, governance frameworks, tax compliance, and revenue sustainability within extractive industries. The model provides a coherent analytical lens through which fiscal capacity can be understood as an emergent outcome of dynamic and interdependent institutional, technological, and behavioral processes.

Figure 1 illustrates the proposed conceptual framework.

The model assumes a structured and sequential causal pathway in which **Tax Administration Modernization** and **Governance Frameworks** act as the primary driving forces (independent variables), shaping **Tax Compliance** as a central mediating mechanism, which ultimately determines **Revenue Sustainability** as the final outcome.

First, **technological modernization**, through the integration of Artificial Intelligence (AI), Blockchain, and Big Data, enhances the technical capacity of tax administrations. It enables real-time monitoring, improves audit efficiency, and significantly reduces information asymmetry between multinational extractive corporations and tax authorities. This transformation increases the probability of detection and strengthens enforcement capabilities.

Second, **governance frameworks**, through legal design and institutional reforms, provide the necessary regulatory and institutional infrastructure within which technological systems operate. Strong governance ensures transparency, accountability, and adherence to the rule of law, thereby limiting discretionary practices, political interference, and corruption risks.

Third, the interaction between modernization and governance influences **tax compliance behavior**, which is conceptualized in this study as a dual construct. On the one hand, **technical compliance** is driven by enforcement mechanisms and the increased likelihood of detection. On the other hand, **moral compliance** emerges from taxpayers' perception of fairness, institutional legitimacy, and the effectiveness of public spending, reflecting the concept of "universalization reasoning."

Finally, the synergy between these elements leads to **revenue sustainability**, which represents the ability of the state to mobilize stable and resilient domestic resources over time. This outcome is essential for achieving long-term development objectives, including the Sustainable Development Goals (SDGs), and for strengthening fiscal resilience in the face of commodity price volatility.

In this sense, the Integrated Nexus Model conceptualizes fiscal capacity not merely as a function of tax rates or administrative effort, but as an emergent property of the interaction between technology, governance, and taxpayer behavior.

4.1 Model Components and Theoretical Logic

The internal structure of the Nexus Model is built upon four interdependent components that reflect the major transformations observed in global fiscal systems during the period 2020–2025.

(1) The Technological Driver (IV1)

This component represents the transition from traditional, retrospective tax administration toward real-time, data-driven oversight. Through the adoption of AI, Blockchain, and advanced data analytics, tax authorities enhance their capacity to detect irregularities, monitor transactions, and perform predictive risk assessments.

The technological driver primarily addresses the problem of **information asymmetry**, which has historically characterized extractive industries due to their complexity and the dominance of multinational corporations. By reducing this asymmetry, modernization strengthens the technical foundations of compliance.

(2) The Governance Driver (IV2)

Governance functions as the institutional backbone of the model. It encompasses legal design, regulatory quality, and the effectiveness of oversight mechanisms. This component ensures that technological advancements are embedded within a framework of transparency, accountability, and rule of law.

Without strong governance, digital tools risk becoming ineffective or even counterproductive, as they may be undermined by political interference or institutional corruption. Therefore, governance acts as a **steering mechanism** that translates technical capacity into credible and enforceable fiscal outcomes.

(3) The Compliance Mediator (MV)

Tax compliance represents the central transmission channel through which modernization and governance influence fiscal outcomes. The model conceptualizes compliance as a **dual-dimensional construct**:

- **Technical Compliance**: driven by enforcement, audit capacity, and the increased probability of detection resulting from digitalization.
- **Moral Compliance**: driven by trust in institutions, perceived fairness, and the internalization of fiscal responsibility, as explained by the concept of universalization reasoning.

This dual structure highlights that sustainable compliance cannot be achieved through coercion alone, but requires a combination of enforcement efficiency and institutional legitimacy.

(4) The Sustainable Outcome (DV)

Revenue sustainability constitutes the ultimate objective of the model. It refers to the state's ability to generate stable, predictable, and resilient fiscal revenues over time, particularly in the context of extractive industries characterized by price volatility and complex global value chains. Through the effective functioning of the Nexus, states can achieve **financial sovereignty**, reduce dependency on external financing, and enhance their capacity to support long-term economic and social development.

4.2 Research Hypotheses Development

The Integrated Nexus Model operationalizes the study's theoretical assumptions through three main hypotheses that describe the causal relationships between its components:

H1: Technological Effect

Tax administration modernization has a positive and significant effect on tax compliance by enhancing detection capacity, reducing information asymmetry, and improving audit efficiency. → (IV1 → MV)

H2: Governance Effect

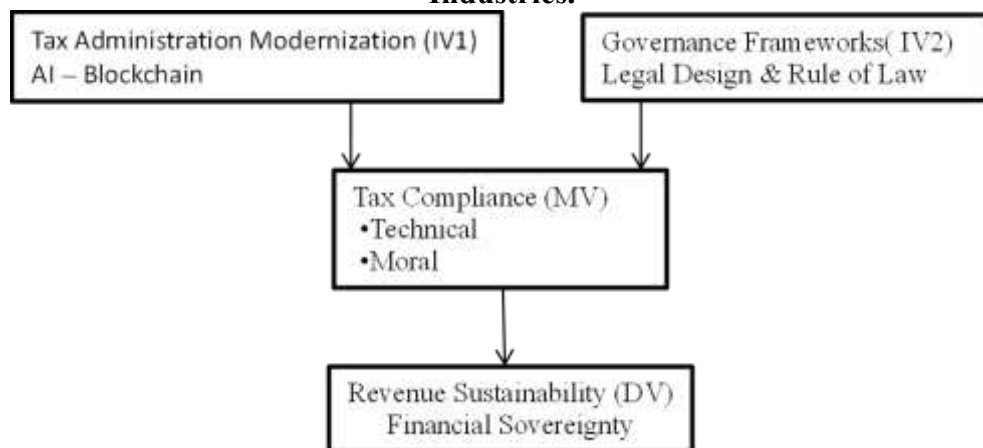
Governance frameworks positively influence tax compliance by strengthening legal certainty, increasing transparency, and fostering institutional trust. → (IV2 → MV)

H3: Mediated Effect

Tax compliance mediates the relationship between tax administration modernization, governance frameworks, and revenue sustainability. In other words, modernization and governance do not directly

ensure sustainable revenues unless they effectively translate into higher levels of compliance. → (IVs → MV → DV)

Figure1: The Integrated Nexus Model of Fiscal Capacity in Extractive Industries.



Source: Developed by the authors based on literature (2020–2025).

5. Discussion

In light of the Integrated Nexus Model presented in Figure 1, the evidence from Algeria and other resource-rich nations suggests that the synthesis of global trends and theoretical frameworks identified between 2020 and 2025 reveals that the relationship between tax administration modernization, governance, and revenue sustainability is not merely additive but profoundly multiplicative. The evidence gathered from both academic literature and institutional reports suggests a dynamic "Nexus Model" where technology acts as the engine, legal design as the steering mechanism, and long-term fiscal stability as the ultimate destination. A primary observation of this study is that digital tools, such as Artificial Intelligence (AI) and Blockchain, do not operate in a vacuum; their efficacy is strictly bounded by the quality of the surrounding governance framework. As emphasized by Abdullah and Almaqtari (2024) and Besseri and Saidi (2025), while Industry 4.0 technologies offer unprecedented capabilities for data integrity and predictive auditing, they require a robust "Legal Design" to translate digital inputs into actual revenue.

Building on this, the analytical framework developed by the **IMF (2025)** and **Sofrona et al. (2025)** confirms that in many resource-rich nations, the introduction of e-filing or AI-based risk profiling has occasionally failed to curb evasion when the legal mandate of tax authorities

remained politically compromised. This reinforces the argument that modernization is as much a political and legal challenge as it is a technological one. Governance provides the necessary "Rule of Law" to ensure that the "Immutable Records" provided by Blockchain are actually utilized to hold powerful extractive actors accountable. This leads to a second critical observation regarding the move away from purely coercive tax administration toward a model of "Moral Internalization." The "Universalization Reasoning" model proposed by **Muñoz-Sobrado (2025)** provides a compelling explanation for why some states escape "low-capacity traps." Modernization serves a dual purpose here: it increases the "Probability of Detection" through AI-driven audits (**Septarini & Ismanto, 2024**), but it also signals "State Quality."

For resource-rich countries like **Algeria**, where the extractive industries account for over 90% of export revenues and form the backbone of the national budget, this nexus between digitalization and governance takes on particular urgency. The Algerian context, especially as observed through the academic lens of institutions such as the **University of Ouargla**, highlights the practical challenges of transitioning toward a digitalized fiscal ecosystem. Recent national reforms in tax administration, including the progressive implementation of electronic filing systems and the modernization of the "Direction des Grandes Entreprises" (DGE), align closely with the global trends identified in this review. However, as is common in many emerging economies, challenges related to institutional coordination and the integration of data across the energy and finance sectors persist, requiring a more integrated approach to "Legal Design."

This transparency, described by the **World Bank (2020)** as the "disinfecting effect of sunlight," fosters a moral environment where compliance becomes an internalized obligation. In the extractive sector, where the "Social Contract" is often strained by perceptions of corruption, this transparency effect is essential for long-term sustainability. However, revenue sustainability in the 2020-2025 era has been tested by extreme commodity volatility and the energy transition. The **OECD (2025)** and **United Nations (2021)** emphasize that "Fiscal Capacity" is the bedrock of resilience. The nexus model demonstrates that states with integrated, autonomous revenue bodies are better equipped to handle "revenue shocks." By using AI to monitor production and transfer pricing in real-time, these states can mitigate tax avoidance that often spikes during economic downturns. Furthermore, as the world moves toward a green economy, the governance of "Critical Minerals" will require the same level of digital oversight currently applied to oil and gas to prevent new forms of revenue leakage (**OECD, 2025**).

Extending this logic, a critical point of concern remains the "Digital Divide" and "Institutional Friction" mentioned by **Abdullah and Almaqtari (2024)**. While the nexus model works theoretically, its practical application in fragile or low-income resource-rich states remains challenging due to a lack of "Industry 4.0 readiness" and the risk of "Digital Corruption." For these states, modernization should start with "Foundational Digitalization" supported by "Social Accountability" (**United Nations, 2021**). The goal is to create a "Minimum Viable Governance" that can eventually support advanced AI tools. Ultimately, the discussion confirms that the nexus is a strategic necessity. Revenue sustainability is achieved when technological modernization increases efficiency and governance quality increases trust. These two forces together expand the "Feasible Tax Base" by capturing illicit flows and encouraging voluntary compliance (**Muñoz-Sobrado, 2025; Sofrona et al., 2025**), allowing states to achieve financial sovereignty in the complex 21st-century global economy.

6. Conclusion and Future Research

6.1 Conclusion and Policy Implications

This study has synthesized the evolving relationship between tax administration modernization, governance, and revenue sustainability within the extractive industries during the transformative period of 2020–2025. The core finding suggests that the "Nexus" is not merely a technical arrangement but a strategic ecosystem where technological tools provide the *capacity*, legal design provides the *legitimacy*, and moral internalization provides the *sustainability*. Moving beyond the initial premises of Industry 4.0, the analysis demonstrates that while AI and Blockchain are instrumental in enhancing audit depth and data integrity (**Septarini & Ismanto, 2024; Besseri & Saidi, 2025**), their fiscal impact is fundamentally mediated by the quality of the institutional "Legal Design" (**IMF, 2025**).

The evidence indicates that revenue sustainability is increasingly dependent on a "Moral Channel" of compliance. When modernization efforts are perceived as transparent and fair, they trigger a "Universalization Reasoning" among extractive firms, where compliance is seen as a contribution to a functioning social contract rather than a cost to be avoided (**Muñoz-Sobrado, 2025**). This shift from a purely coercive fiscal model to a legitimacy-based one represents the new frontier for resource-rich nations navigating the post-pandemic economic landscape.

Policy Implications: For policymakers, particularly in emerging resource-dependent economies like Algeria, these findings suggest that the

path to financial sovereignty requires a holistic "Triple-Helix" strategy. First, investment in digital infrastructure must be accompanied by a "Legal-First" approach, where modernization is anchored in clear statutory mandates to prevent discretionary interference. Second, tax authorities should leverage the "transparency effect" of digital tools to signal institutional quality, thereby reducing the "information asymmetry" that often leads to elite capture. Finally, domestic resource mobilization should be framed as a governance outcome, where the efficiency of tax collection is directly linked to the visible effectiveness of public resource management.

6.2 Future Research Directions

To ensure the continued relevance of fiscal policies beyond the 2025 horizon, future research should transition from broad theoretical mapping to targeted empirical investigations in the following areas:

➤ **The Digital-Institutional Gap in Fragile Contexts:** There is a critical need for longitudinal case studies on low-income, resource-dependent nations to identify the "Minimum Viable Digitalization" required to trigger governance improvements. Research should investigate how "Foundational Digitalization" (e.g., e-filing and basic data integration) can be effectively scaled into advanced AI-driven systems without exacerbating existing institutional weaknesses or "Digital Corruption" (Abdullah & Almaqtari, 2024; United Nations, 2021).

➤ **Algorithmic Governance and Taxpayer Rights:** As AI moves to the center of tax risk profiling, future studies must explore the legal and ethical implications of "Algorithmic Transparency." Specifically, research is needed to determine how automated tax assessments in the extractive sector can be designed to ensure accountability, prevent algorithmic bias, and protect the rights of taxpayers in an increasingly autonomous fiscal environment (Septarini & Ismanto, 2024).

➤ **Fiscal Governance of Critical Minerals and the Green Transition:** With the global shift toward renewable energy, the "Modernization-Governance Nexus" must be tested within the critical minerals sector (e.g., lithium, cobalt). Future research should analyze how the complexities of green energy supply chains and the resulting revenue leakage risks require specialized digital oversight and international tax coordination to ensure a just and transparent energy transition (OECD, 2025).

In summary, the next frontier of fiscal capacity will not be defined by the discovery of new physical resources, but by the innovative discovery of systemic ways to govern and modernize the mobilization of the resources we already possess.

Bibliography

- Abdullah, A. A. H., & Almaqtari, F. A. (2024). The impact of artificial intelligence and Industry 4.0 on transforming accounting and auditing practices. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(2024), 100218.
- Besseri, R., & Saidi, F. (2025). The Future of the Auditing Profession in the Era of Digital Transformation Technologies: Blockchain Technology as a Model. *El-Manhel Economy*, 8(1), 2025.
- IMF. (2025). Strengthening Tax Governance Through Legal Design. IMF Working Paper (WP/25/17), Washington, D.C.
- Muñoz-Sobrado, E. (2025). Universalization and the Origins of Fiscal Capacity. arXiv:2510.17481v1 [econ.GN].
- OECD. (2025). Global Outlook on Financing for Sustainable Development 2025: Towards a More Resilient and Inclusive Architecture. OECD Publishing, Paris.
- Septarini, D. F., & Ismanto, H. (2024). Transforming Audit with AI: Navigating the Inevitability and Challenges of Accounting Digitalisation. *International Journal of Engineering Research & Technology (IJERT)*, 13(07).
- Sofrona, L., Waerzeggers, C., & Crowley, B. (2025). Strengthening Tax Governance Through Legal Design. IMF Working Paper.
- United Nations. (2021). United Nations Handbook on Selected Issues for Taxation of the Extractive Industries by Developing Countries. United Nations, New York.
- World Bank. (2020). Enhancing Government Effectiveness and Transparency: The Fight Against Corruption (Global Report). World Bank Group, Washington, D.C.