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(IJIREV)**www.gaexcellence.com/ijirev**ECONOMIC VALUE OF MINERAL EXTRACTION AND
PRODUCTION: BENCHMARKING BEST MINING
PRACTICES IN AUSTRALIA, CHINA, CANADA AND
NORWAY**

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Abstract:

Despite the growing importance of sustainable mineral development, there is still limited integration of economic valuation, ESG considerations, governance quality and policy alignment within existing mineral valuation frameworks particularly in Malaysia. Key issues include inconsistent valuation approaches, weak integration of environmental, social and governance (ESG) factors and limited downstream industrial linkages, which constrain optimal resource monetization. This study benchmarks best mining practices in Australia, China, Canada and Norway to develop a comprehensive mineral economic valuation model applicable to Malaysia. The study employs a hybrid valuation framework that integrates resource, market,

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cost and policy perspectives, and is supported by a cross-country comparative analysis using PESTEL frameworks. The findings show that effective mineral value creation is dependent not only on the availability of resources but also on the quality of governance, downstream industrial development, technology capability, stakeholder engagement, environmental sustainability and supportive regulatory frameworks. The proposed Mineral Economic Valuation Model offers an integrated framework that supports evidence-based policy formulation, enhance regulatory effectiveness, optimize mineral revenue generation and promote sustainable mineral resource development in Malaysia.

Keyword:

Mineral Extraction, Mining, Economic Valuation Model, Valuation Approaches, Resources Management



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Introduction

Global demand for minerals is rising because of the energy transition and the digital economy. However, many countries do not include downstream processing and governance factors, only the value from extraction (Drusche & Krause, 2021). Extraction-centred strategies proponents argue that such approaches generate fast income and exploit resources with less initial investments. This approach, however, often ignores long-term sustainability and value chain improvement. This study seeks to address this gap by comparing mining practices across leading jurisdictions. It focuses in particular on the way in which countries such as Australia, China, Canada and Norway use strong governance frameworks, include environmental and social factors and make strategic investments in downstream industrial development to maximize the economic value derived from their mineral resources (Anzolin & Pietrobelli, 2025; Shi et al., 2023). The analysis attempts to identify the best strategies to maintain a balance between extraction and value addition while ensuring sustainable resource management and fair benefit sharing. The aim is to develop a framework that incorporates resource, market, cost and policy factors to assist in identifying key drivers of value creation in the mineral extraction and production industry. This integrated method requires an understanding of different valuation techniques, from discounted cash flow for well-explored areas to more complex models that incorporate policy-driven market dynamics and environmental, social, and governance performance (Bykowa et al., 2023; Fikru, 2024; Lin et al., 2025).

Additionally, this study explores the effect of certain global value chain characteristics on policy design. It acknowledges that industrial policies for the mining sector often lack a comprehensive view, taking into account the interrelations and integration of the various actors.

This analytical framework extends beyond traditional economic models to encompass the geopolitical factors and global trade dynamics impacting the relationship between minerals and energy. This area has not been given much attention in policy-oriented research (Fikru, 2024). The study reveals that a combined approach to mineral resource valuation that involves both extraction and value addition is important in dealing with the “resource curse”. Many resource-rich countries face challenges in translating their resource wealth into broad-based economic prosperity (Brunet et al., 2023). In particular, it aims to clarify how strong legal and institutional frameworks can contribute to the fair distribution of rents and sustainable development in the extractive sector (Bergamini et al., 2025).

The study also examines active industrial policies in the mining sector, which are important to convert raw materials into continuous economic development by strengthening links in global value chains. Furthermore, the research highlights the importance of understanding ore behaviour throughout the mineral processing pipeline. The detailed characterization of minerals is an essential step to develop sustainable mining practices and innovations to solve the environmental and social problems (Ntlhabane et al., 2017). This includes detailed studies of the effects of natural mineral impurities and moisture content on dangerous coal seam properties and their effects on the safety and environmental effects of mining operations. This level of detail is essential for guiding policy decisions that foster sustainable resource management and mitigate risks in the extractive sector. The study asserts that alignment between demand-side and supply-side policies is crucial for building productive capabilities in the mining sector (Anzolin & Pietrobelli, 2025). By analyzing the interaction between these policy areas, the research attempts to show the potential of well-coordinated regulations to promote innovation, increase competitiveness, and attain a more equitable distribution of mineral rents, hence contributing to sustainable economic growth and governance stability in resource-rich countries.

Literature Review

Economic Value of Minerals

The economic value of minerals is determined by resource quantity, quality, market price and cost (Vidal et al., 2021). Kerr (2023) states that governance and ESG factors also significantly affect investment appeal and sustainability. Existing research often separates economic and policy analysis, leaving a gap that this study addresses. In particular, the paper explores the role of policy regimes and institutional quality in mineral rich countries and the extent to which they can transform resource wealth into sustainable economic growth, beyond simple rent extraction. Numerous resource curse studies center on corruption, poor governance and environmental degradation in mineral-rich countries. However, there is little economic analysis on the impact of mineral resources on long-run development, particularly in terms of policy frameworks and institutional quality (Anser et al., 2025). This study examines the perspectives of business stakeholders on mineral value addition policies and identifies key factors that influence a nation’s competitive and comparative advantages in the mineral sector. These factors include firm strategy, structure, and competition, as well as essential factor conditions that are crucial for optimizing resource use and industry output (Firmanto et al., 2025).

Valuation Process for Minerals

The valuation of mineral assets requires a departure from the traditional market, revenue and cost approaches. It has to adequately take into account uncertainties and flexibilities in decision making often omitted by traditional economic models. Therefore, there is need for a comprehensive framework for mineral producing countries to identify and evaluate policy options to attract downstream processing. This will help to align the incentives of demand with the development of supply capabilities (Anzolin & Pietrobelli, 2025; Hamdani, 2023). This wider view should consider the complexities of global mineral value chains, including cross-border environmental and social issues that frequently go beyond the scope of national policy frameworks. The closure of these gaps requires the development of systematic and detailed frameworks that proactively identify specific barriers along mineral value chains. This enables policymakers to create effective responses to growth challenges (Zyl et al., 2020). Such frameworks must shift away from focusing solely on extraction. They should consider integrated policies that tackle sectoral interdependencies, diverse stakeholders, and impacts on local and global levels (Kügerl et al., 2022). This approach acknowledges that, while the mineral industry can develop infrastructure and improve social services, it also faces inherent challenges such as volatility, uncertainty and exhaustibility. Therefore, strong policy interventions are needed to avoid the "resource curse."

Moreover, it is important to understand the main cost drivers in different value chain sectors in order to grasp how sensitive these sectors are to changes in key input prices. This knowledge informs strategic policy decisions (Zyl et al., 2020). This includes evaluating the effect of government policies (financial incentives, regulations, etc.) on downstream markets and the competitiveness of domestic mineral processing operations. Furthermore, the analysis of these cost drivers should also consider how structural mismatches in exploration valuation could be indicative of a broader trend of exploration activity being partially decoupled from economic justification. This can reflect increasing geological challenges, strategic exploration efforts, or changing investor expectations (Díaz et al., 2025). This calls for a comprehensive analysis of demand and supply elasticities to accurately assess how market variables respond to policy changes and to quantify the expected economic shifts. Such wide-ranging analysis aims to improve the understanding of the effectiveness of policies towards the promotion of sustainable mineral value chains. It goes beyond the mere analysis of policy types to the assessment of their actual impacts on the development and growth of the industry. However, the analytical tools used for value chain analysis are largely restricted to past investigations and governance issues. They lack a systematic approach to foresight analysis or in identifying barriers to growth within the chain. This requires a transition to proactive frameworks that recognize and address limiting factors throughout the mineral value chain. This will support evidence-based policy development and help reduce instances of policy failures (Zyl et al., 2020). It requires a deep understanding of the various cyclical and systemic constraints that hold back beneficiation industries as well as identifying the different barriers across tiers of the mineral value chain. This approach must take into account commodity-specific demand growth rates and fluctuations, as well as econometric methods to estimate elasticities. This will help model demand shifter values and enable more complex, specific forecasts (Ryter et al., 2025).

Hence, a detailed assessment of industrial policies along the mining value chain including government facilitation, regulation and direct intervention is necessary to promote value addition and reduce the risks associated with price volatility and poor coordination among stakeholders. Such actions are important to address the long-term nature of mining projects and

the large initial sunk costs and coordination failures that often lead to suboptimal levels of investment in the mining sector. But existing analyses of these policies frequently overlook crucial aspects such as the interdependencies between different value chain sectors and the specific impacts on supply and demand dynamics. This requires a more integrated approach, one that draws on insights from global value chains to understand how different policy tools can be balanced and coordinated to effectively promote upstream and downstream linkages (Anzolin & Pietrobelli, 2025).

Methodology

This study uses a comparative case study approach to analyze leading mineral-producing countries, including Australia, Canada, China and Norway, to identify best practices in mineral value chain management and policy effectiveness (Firmanto et al., 2025).

Comparative analysis using PESTEL

The study proposes a systematic classification of macro-environmental factors to assess the feasibility of downstream diversification. It ensures that the strategic policy design is in line with the infrastructure gaps and the governance capacity. Moreover, the methodology offers a taxonomy of these macro-environmental factors, allowing the systematic identification of vertical and horizontal linkages, which are important for sustainable industrial development (Anzolin, 2021).

Steps of PESTEL Analysis

In order to perform the PESTEL analysis in this study, a multi-stage analytical process is applied to evaluate the feasibility of downstream value chain integration:

Political: Evaluation of the stability of the government, fiscal policy, trade agreements and the political will, which affects long term investment security and policy coherence.

Economic: Assessment of macro-economic indicators, fluctuations in commodity prices and demand elasticities to establish the economic viability of value-added processing and diversification.

Social: Assessment of stakeholder engagement, labor standards, and the wider impact of mineral extraction on local communities, human development and equity.

Technological: Evaluation of existing mineral processing facilities, potential for innovation, and technology readiness level to improve production efficiency.

Environmental: Evaluation of ESG compliance, sustainability frameworks and ecological safeguards required to mitigate the environmental impact of resource extraction.

Legal: Review of regulatory consistency, anti-corruption measures, and the robustness of institutional frameworks that define the 'rule of law' within the mining sector.

This stepwise approach will ensure the design of the strategic policy will be based on a holistic view of the macro-environmental landscape, which will identify the potential barriers and the critical vertical and horizontal linkages required for sustainable industrial growth (Anzolin, 2021; Moerenhout, 2026).

Results and Discussion

Comparative Analysis

Based on comparative analysis, Australia excels in production efficiency, particularly regarding the economic aspect of the Mineral Value Processing Benchmarking Index. This is due to its well-developed mining infrastructure, cutting-edge technologies, and streamlined regulations that minimize operational downtime while maximizing output per resource unit (Fikru, 2024). Canada leads in governance and transparency, scoring highly in the ESG and policy areas due to its robust institutional frameworks, mandatory disclosure rules, and widespread stakeholder engagement that reduce risks and build investor confidence. Furthermore, Kügerl et al. (2022) dominate in downstream processing and industrial scaling, driven by comprehensive industrial policies such as subsidies, infrastructure investment, and regulatory mandates that encourage beneficiation and vertical integration throughout the value chain.

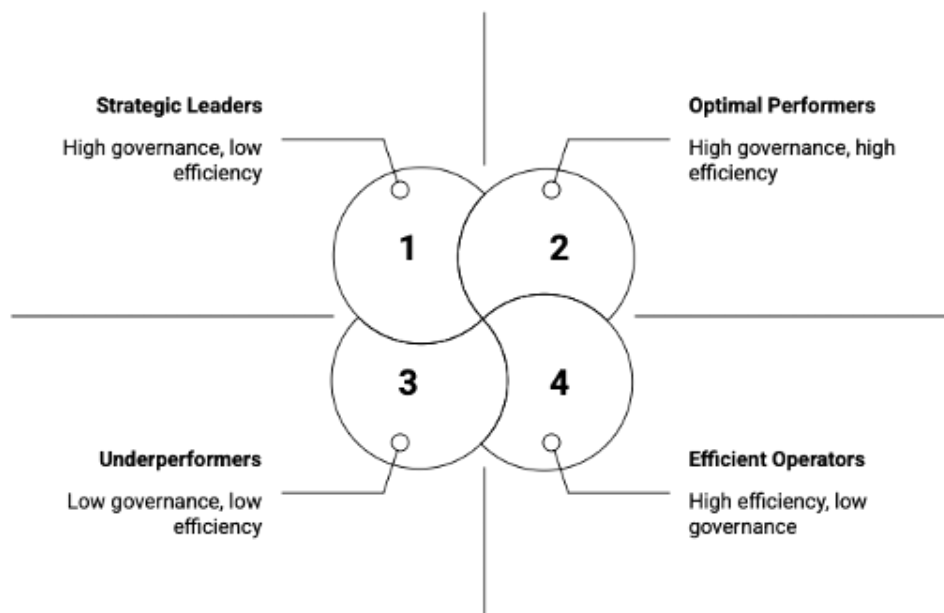


Figure 1: Optimization of Resources Allocation

Source: Author Research

Figure 1 illustrates that, collectively, these case studies demonstrate that optimal mineral value chain performance is achieved through a dynamic interplay of economic efficiency, robust governance, strategic industrial policies and integrated sustainability frameworks. This comparative analysis shows the importance of a multi-faceted approach, with no single country having a one-size-fits-all model, but rather different strengths that can be synergistically combined to optimize global mineral resource governance (Bravo, 2022; Vivoda et al., 2025). This highlights the necessity of exploring country-specific settings to comprehend how various governance models and socio-economic elements impact mineral resource management (Mutemeri, 2024). Such an understanding is crucial for crafting tailored strategies that improve local value creation, ensuring that mineral resource rents translate into broader economic development and green growth. However, many countries, despite having substantial mineral resources, struggle to translate this endowment into significant economic benefit due to deficiencies in competencies, institutional frameworks, and effective linkages. These

limitations often manifest in a "resource curse," characterized by an overreliance on raw material exports, limited diversification, and vulnerability to global commodity price fluctuations, further exacerbated by weak governance and corruption (Mufungizi & Mpaka, 2025).

On the other hand, resource rich countries such as the USA, Canada and Australia with strong governance structures and clear regulatory environments show that resource abundance can be a good driver for sustainable growth and economic diversification. This divergence highlights the importance of effective governance practices and transparent institutional arrangements in addressing the "Paradox of Plenty" and promoting inclusive economic development in resource-endowed countries (Alemzero & Shi, 2023; Wu, 2024). Effective governance frameworks for mineral resources are therefore imperative to ensure that resource extraction contributes to sustainable development through transparency, capacity building and institutions that align the interests of diverse stakeholders while safeguarding against corruption. This is most evident in the distinction between the well-established mining economies of the OECD countries such as Australia and Canada, with their strong institutional frameworks and low social and political risk, and countries where systemic governance failures lead to exclusion and environmental degradation despite rich mineral endowments (Amoah et al., 2026; Owen et al., 2023).

In addition, the problem is the "one-size-fits-all" approach to institutional development that often overlooks the specific political, economic and social contexts of mineral-rich developing countries. The "paradox of plenty" is often found in low-income, mineral-rich states, where poor governance, corruption and a lack of transparency prevent the conversion of mineral endowments into national economic prosperity. This phenomenon, commonly referred to as the "resource curse," causes many social, economic, environmental, and political problems for these countries. These problems are often compounded by rent-seeking governments that manipulate the economy for opportunistic ends, creating an environment in which resource revenues are diverted to illicit transactions rather than to sustainable development programs. This situation shows how the existence of significant natural resource wealth, without strong governance, can paradoxically hinder the development of a nation, leading to increased corruption, economic instability, and conflict instead of widespread societal benefits. This requires a comprehensive analysis of the mechanisms through which institutional quality and governance affect the impact of resource abundance in worsening or mitigating these adverse effects (Cust, 2018; Kansheba & Marobhe, 2022; Narh, 2023).

Discussion

The results indicate that countries with good governance and downstream processing have the highest economic value. Downstream value is dominated by China, governance by Canada and sustainability by Norway. Such findings support previous research that highlighted the importance of high regulatory quality and effective corruption control as prerequisites for translating the mineral rents into sustainable economic growth and overcoming the "resource curse" often faced by resource-rich nations (Anser et al., 2025; Shi et al., 2023). On the other hand, resource-rich countries often find it difficult to harness their natural wealth as a result of weak institutions and poor governance. For instance, the Democratic Republic of Congo has substantial reserves of cobalt and copper, but has faced social unrest and slow economic development, while countries such as Australia and Canada have used mineral rents to stimulate economic growth through strong regulatory performance. This deviation highlights

the significance of institutional quality and good governance in translating natural resource endowments into sustainable development outcomes, underscoring that economic benefits are significantly enhanced when policy implementation and regulatory frameworks are effectively managed. In fact, the poor governance systems in mineral-dependent countries often result in a disconnect between economic growth and environmental progress. This highlights the importance of incorporating environmental considerations into resource management approaches to counteract detrimental ecological impacts (Qiu, 2024).

Furthermore, empirical evidence shows that robust governance indicators such as voice and accountability, government effectiveness, and control of corruption significantly alleviate the extent of the resource curse in the short and long run (Alemzero & Shi, 2023; Wang & Su, 2024). This perspective highlights the importance of institutional quality as an important intervening variable that can turn potential resource curse situations into opportunities for sustained economic development. This is also reflected in the fact that countries with good institutional quality and good resource governance frameworks are better positioned to leverage their natural endowments for long-term economic sustainability. Strong institutional capacity allows for proper revenue management, strategic investment across a range of sectors, and transparent fiscal policies that ensure that resource rents are directed toward public welfare and infrastructure development rather than toward rent-seeking or economic volatility. This implies that the resource-rich countries need to improve their institutional quality to prevent the resource curse and instead turn the natural resource abundance into a catalyst for socio-economic development (Destek et al., 2022).

In particular, strong institutions and good governance, including transparency, accountability and regulatory capacity, are critical to ensure that resource rents are directed to public goods and long-term investments, thereby contributing to positive economic growth and sustainable development. This view redefines the concept of the “resource curse” as a “institutions curse.” This means that natural resources are not an impediment to development per se, but bad institutions that worsen the ill effects (Schorr & Damonte, 2021). Empirical evidence indicates that high institutional quality can transform the negative potential effect of natural resources into a positive contribution to economic growth. In contrast, institutions that are friendly to grabbers tend to hinder economic growth and sustain the resource curse by offering opportunities for rent-seeking. Grabber-friendly institutions are characterized by a lack of transparent governance and accountability mechanisms. This is consistent with the view that natural resource endowments are a blessing if institutions are strong, and a curse otherwise, i.e., the strength of institutions is a prerequisite for good things to come from resource abundance (Hodler et al., 2023). In this respect, the empirical analyses generally find that the effect of resources on economic growth is less negative and often positive when institutional quality is effectively controlled for, especially when interaction terms between institutional quality and natural resources are included. Therefore, the negative consequences of resource abundance are indirect and non-monotonic because they only appear when the institutional framework allows for rent-seeking and macroeconomic policy failures (Szalai, 2018).

Moreover, the usual growth-reducing effects of oil revenue volatility can be largely offset by the adoption of growth- and welfare-enhancing policies and institutions, highlighting the role of policymakers in converting resource endowments into economic growth. This implies that good governance and sound institutional structures are not only desirable but are in fact prerequisites for resource-reliant nations to effectively channelize their natural capital for sustained economic development and avoid widespread problems of resource curse.

Furthermore, the adverse impact of resource abundance on economic growth is frequently found in the context of state ownership and control, particularly in the case of low institutional quality, while the growth can be reversed by an improvement in institutional quality (Khanna, 2017). This suggests that the resource curse is not an inevitable effect of resource abundance, but rather a result of underdeveloped institutional structures that do not effectively manage resource-generated wealth (Havránek, et al., 2016).

Policy Implications

In mineral rich areas like Sarawak, the policy should be downstream development as successfully undertaken by Malaysia on REE processing infrastructure and stressed in industry policies across the mining value chains. In fact, ESG integration enhances governance, reduces environmental risks, and allows for sustainable investment (Bravo, 2022; Mufengizi & Mpaka, 2025; Qiu, 2024) and hybrid valuation models for the prediction of growth constraints and the integration of economic, social and environmental measures. High performing countries such as Canada and Australia have adopted a multi-faceted approach that will maximise economic returns, transform resource rents into diversified growth and stave off resource curse problems through strong institutional frameworks. This approach aligns with the findings that the quality of institutions is a common denominator for the countries that have successfully escaped the resource curse, developed or developing (Narh, 2023). Hence, Sarawak needs to strengthen its institutional architecture and governance frameworks in order to manage its mineral wealth effectively in the pursuit of sustainable development and economic diversification. The findings suggest that continued institutional development, a clear regulatory framework and strong enforcement of the law are necessary to protect growth.

Conclusion

The economic value of minerals is determined not just by geology but also by governance, policy and value chain integration. Countries with integrated systems reach better and more sustainable economic results (Kesler & Simon, 2015). This highlights the need for robust governance frameworks and strategic policy interventions to leverage the benefits from mineral resources, especially in the context of the global transition to a green economy and rising demand for critical minerals. Ultimately, sustainable management of mineral resources requires an integrated approach that incorporates environmental stewardship and socio-economic progress, reducing vulnerabilities tied to resource reliance and promoting long-term wellbeing. This holistic view positions the extraction of mineral resources not as an end in itself, but as a strategic tool for the achievement of broader sustainable development objectives, as evidenced by countries such as Chile and Botswana that have successfully directed revenues from mineral resources to social initiatives and sound infrastructure, helping to reduce poverty and improve health services (Affairs, 2025). Thus, to maximize in-country value creation and the equitable sharing of the benefits of resources across generations, it is critical to build strong linkages between the mining sector and other sectors of the economy, including local resource supply chains and beneficiation activities.

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