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On the Unintended Consequences of Critical Mineral Bans: The Exploration Channel

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Abstract

Critical mineral maps portray known resource endowments as fixed geographic facts, yet the resource base is endogenous to both demand conditions and institutional factors. The prevailing framing of critical mineral scarcity ignores the extent to which resources are discovered only when it is profitable to do so. Using a two-region model of endogenous reserves, we show that exploration investment and discovered reserves respond to global demand shocks, world resource prices, and the institutional environment facing international resource companies, including explicit and implicit taxes on exploration and on exports, including export bans and restrictive trade measures in pursuit of value-chain upgrading. While export bans may be attractive as industrial policy, they risk being self-defeating: by discouraging exploration investment, they reduce the very resource base on which industrial ambitions depend. We document the global proliferation of export restrictions on critical minerals and discuss the policy implications for developing countries navigating the twin pressures of resource nationalism and the green transition.

Keywords: critical minerals, endogenous resources, exploration investment, export ban, resource nationalism, green transition, developing countries.

JEL Codes: Q31, Q32, Q38, F13, O13.

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1. Introduction

The global green transition has generated extraordinary demand for a suite of minerals—cobalt, lithium, nickel, copper, rare earth elements, and many others—that are essential inputs into batteries, wind turbines, electric vehicles, and the digital infrastructure of modern economies. The International Energy Agency projects that demand for these critical minerals will more than quadruple by 2040 for clean energy technologies alone (IEA, 2025). Against this backdrop, the dominant policy narrative in consuming countries and international organisations focuses on the geography of supply: maps of known reserves, concentration ratios, and the strategic vulnerability of mineral import dependence.

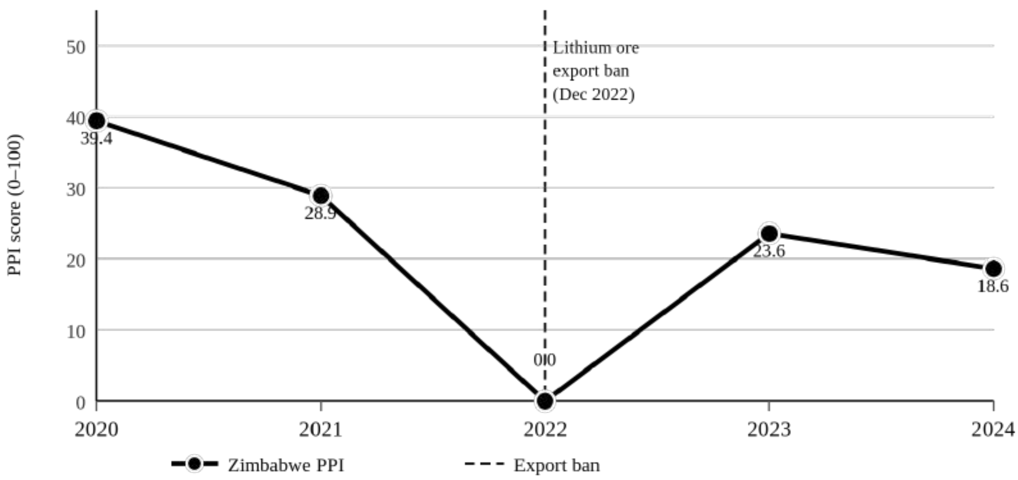
This framing treats the known resource base as exogenous, i.e. a natural endowment given by geology and revealed by past exploration. Yet such maps are artifacts of investment decisions, not nature alone. Reserves appear on maps because companies found it profitable to search for them under prevailing prices, technologies, and institutional conditions. Where the investment climate is hostile or returns are uncertain, deposits remain unknown or undeveloped. Known resources are, in a fundamental sense, endogenous to the very policies and institutions that govern access.

We develop and apply that insight to the contemporary critical minerals landscape. We do so in three steps. First, we introduce a two-region theoretical framework showing formally that discovered reserves of critical minerals are increasing in global demand, world prices, and market openness, and decreasing in taxes or institutional barriers facing international resource companies (IRCs). Second, we document a striking and underappreciated empirical trend: the proliferation of export bans and other restrictive trade measures on critical minerals by resource-rich developing countries seeking to move up the value chain. Third, we argue that such policies, while politically appealing, contain a self-defeating logic—by deterring upstream exploration investment, they erode the very resource base on which downstream industrial ambitions depend.

The policy stakes are high. As Arezki and van der Ploeg (2023; 2025a,b) observe, resource-rich developing countries face a delicate balancing act between outward-facing institutions that attract foreign exploration capital, on the one hand, and inward-facing institutions that govern revenue distribution and domestic development, on the other hand. Export bans tilt this balance sharply toward the latter, with consequences that ripple back to the upstream investment environment in ways that are rarely accounted for in policy discussions. The self-defeating dynamic we highlight is especially consequential for the least-developed countries, where mineral wealth may be the primary engine of structural transformation.

Figure 1. Policy Perception Index: Zimbabwe, 2020–2024

Higher scores indicate a more attractive policy environment for mining exploration investment



Notes: The dashed vertical line marks the announcement of Zimbabwe's lithium ore export ban (Statutory Instrument 213/2022, December 2022). The survey year reflects conditions in the prior calendar year; the 2022 survey (conducted August 2022–January 2023) captures investor sentiment around the time of the ban announcement. Zimbabwe scored 0.0 in 2022 — the lowest possible score — ranking last globally (62nd of 62 jurisdictions surveyed). Despite a partial recovery in 2023, the score fell again to 18.6 in 2024, leaving Zimbabwe ranked 71st of 82 jurisdictions. Zimbabwe ranked 21st of 58 on the Best Practices Mineral Potential Index in 2024, indicating that the low PPI reflects institutional conditions rather than absence of mineral endowment. The February 2026 expansion of the ban to all raw minerals and lithium concentrates will be captured in the 2025 survey edition.

Source: Fraser Institute, *Annual Survey of Mining Companies*, 2020–2024 (Table 2: Policy Perception Index). Mejía, J. and Aliakbari, E. Vancouver: Fraser Institute. Available at: www.fraserinstitute.org.

A Zimbabwe's lithium ore export ban instituted in December 2022 is a case in point of the self-defeating nature of such bans. Despite holding some of the world's most significant deposits of critical minerals, Zimbabwe ranking 21st globally on the Fraser Institute's Best Practices Mineral Potential Index in 2024 and it has seen their Policy Perception

Index scores collapse to among the lowest recorded (see Figure 1). Zimbabwe hitting the minimum possible score of zero in 2022, the year of its lithium ore export ban. In 2025, the Democratic Republic of Congo (DRC) followed suit and imposed cobalt export suspension (February 2025) then a quota system (October 2025). In the case of DRC ban because cobalt is a byproduct of the production of copper, the deterrent effect falls more heavily on *new and frontier exploration* — junior miners and greenfield projects that cannot absorb the stockpiling costs — and on accelerating substitution toward cobalt-free battery chemistries, which permanently reduces long-run cobalt demand. The divergence between geological endowment and investor sentiment is precisely the mechanism the model presented in the paper predicts: export restrictions and institutional uncertainty do not diminish the resource base in the ground, but they suppress the exploration investment needed to discover, delineate, and develop it, leaving substantial mineral wealth effectively stranded.

In a seemingly contradictory development, Indonesia's nickel ban has been associated with a surge in downstream FDI driven by Chinese smelter investment (see Bosker, van den Herik, Pelzl and Poelhekke, 2025). Notwithstanding that unlikely successful run, Indonesian miners now actually import nickel ore from the Philippines because the ban made upstream exploration uneconomical. This distinction between upstream exploration (our variable of interest) and downstream processing foreign direct investment (what the banning governments celebrate) is exactly the point our model makes — and the data supports it.

Our paper is related to the theoretical and empirical literature on exhaustible resource exploitation and exploration. Resource exploration and discoveries have been investigated either as a deterministic or a stochastic process (e.g. Pindyck, 1978; Arrow and Chang, 1982; Devarajan and Fisher, 1982). The canonical model is the exploration model developed by Pindyck (1978) where a social planner maximizes the present value of the social net benefits from the consumption of oil and the reserve base can be replenished through exploration and discovery of new fields.[1] We extend this to a two-region model to explore the relationship between exploration investment and discoveries where multinational corporations are faced with explicit taxes and implicit taxes (as

[1] We will use the extraction and exploration investment rates as decision variables. This is a metaphor, since not the extraction rate but the investment in rigs follows a Hotelling rule (Anderson, Kellogg and Salant, 2018).

proxy for lack of market orientation) on their investment in the South but none in the North, and arbitrage between different locations.

Our paper is also related to the literature on the so-called "resource curse".[2] In particular, empirical evidence suggests that the curse in terms of the effect of natural resources on growth is less negative and can even turn positive if the quality of institutions is beyond a certain threshold (e.g. Mehlum, Moene and Torvik, 2006; Boschini, Pettersson and Roine, 2007). While this literature has long focused on the direction of causality running from natural resource endowments and institutions to growth and conflicts, our results suggest that causality running from policies and market orientation to natural resource endowments is equally important. Our focus is on "upstream" rather than "downstream".[3] We are thus concerned with "external" policies and institutions that are geared toward foreign investors who conduct exploration activities. Importantly, our results do not contradict the fact that, subsequent to a discovery, countries with poor "internal" institutions (e.g. weak state capacity) may experience poor economic performance and/or social outcomes or even civil strife.

The remainder of the paper is organized as follows. Section 2 documents the rise in export restrictions on critical minerals. Section 3 presents the theoretical model. Section 4 derives the key implications for exploration incentives and resource endogeneity. Section 5 discusses policy implications, and Section 6 concludes.

2. The Rise of Critical Mineral Export Restrictions

The use of export bans and restrictive trade measures on mineral resources by developing countries has accelerated sharply since 2020. Although resource nationalism is not new, the current wave is distinctive in its scope, targeting the specific minerals at the heart of the energy transition, and in its explicit rationale of forcing value-chain upgrading rather than merely maximizing revenue.

[2] See Frankel (2012), Venables (2016), Ross (2012), and van der Ploeg (2011) for recent surveys.
[3] An interesting recent study by Kirk, Passari and Rey (2026) perform a trade network analysis of concentration, mostly downstream. They conclude that for the 13 electrification metals they study for the period 1995-2023, trade has led to a hub-and-spoke system with China at the centre, built via processing investments, industrial policy, and targeted finance. Hence, restricting access to these metals leads to a much larger price rise in the US and Europe. Geopolitics arises as centrality gives leverage over global prices. This affects the green transition.

Indonesia's 2020 ban on exports of unprocessed nickel is the most cited example and in many respects the template for subsequent policies; e.g. The Diplomat (2022) and S&P Global Market Intelligence (2023). The ban was explicitly designed to force global battery and electric vehicle manufacturers to relocate processing capacity to Indonesia. It succeeded, in a narrow sense, in attracting Chinese investment in domestic nickel smelting—but its broader effects on exploration investment and resource sector openness remain contested.[4]

Zimbabwe imposed an export ban on unprocessed lithium in 2022, seeking similar value-addition incentives; e.g. Global Trade Alert (2022), African Climate Wire (2026), Al Jazeera (2026), McCarthy (2026) and Benchmark Mineral Intelligence (2026). The Democratic Republic of Congo (DRC), which accounts for around 70 percent of global cobalt production, introduced a four-month suspension of cobalt exports in February 2025 to arrest falling prices, subsequently replacing it with a quota system. Namibia has introduced export bans on unprocessed critical minerals too; e.g. Mining Weekly (2023) and IEA Policies Database (2023). Chile has pursued a different but related approach through expanded state involvement in lithium, aiming to control the pace of exploitation and capture a larger share of value domestically.

On the consumer side, China has moved in the same direction from its position as a dominant processor and in some cases producer. In December 2024, China restricted exports of gallium, germanium, and antimony to the United States—key minerals for semiconductor production—and followed with further restrictions in early 2025 on tungsten, tellurium, bismuth, indium, molybdenum, and seven heavy rare earth elements (IEA, 2025). Global Trade Alert (2025) gives an inventory of such methods that China introduced. The IEA documents that the number of export control measures on critical minerals has expanded markedly since 2023, reflecting both geopolitical competition and the growing recognition of minerals as strategic assets.

Table 1 summarizes in detail the principal export restriction measures including their stated rationale enacted since 2020 across a range of critical minerals and producing

[4] Bosker, van den Herik, Pelzl and Poelhekke (2025) study the local labour-market effects of Indonesia's voluntary export ban on unprocessed nickel and bauxite in 2014. Exploiting plausibly exogenous variation in the timing of the ban, opening of new processing facilities, and the location of Indonesia's mineral deposits, this study finds that investments in nickel processing increased employment in nickel in mining districts after an initial dip. The ban only led to very limited investment in bauxite processing, causing bauxite production and local employment to fall.

countries. The pattern is clear: an expanding number of countries are treating restrictions on raw mineral exports as an instrument of industrial policy, motivated by the aspiration to capture value-added at the processing and manufacturing stages of the supply chain.

What the policy debate has largely overlooked is the upstream consequence of these measures. Export bans and processing requirements raise the effective cost of operating in a country for international resource companies, which must now consider not just the economics of extraction but also the constraints on what they can do with the ore. This acts as an implicit—sometimes explicit—tax on their upstream activities, including exploration. The theoretical framework we develop in the next section formalizes this mechanism.

3. A Two-Region Model of Endogenous Mineral Reserves

We formulate a simple two-region model of endogenous critical mineral reserves. The two regions are the "North" (critical-minerals-importing advanced economies) and the "South" (critical-minerals-exporting developing countries). Critical minerals are sold competitively in the global resource market and there is also a well-functioning global capital market. A set of internationally mobile International Resource Companies (IRCs) operates across both regions, allocating exploration and extraction activities to maximize the present value of net returns. They decide on the optimal allocation of their exploration and depletion activities until they are indifferent between operating in the North and the South, so global IRCs arbitrage and relocate exploration across locations until costs of critical mineral exploration across the globe are equalized. The key asymmetry in this framework is that the South imposes explicit or implicit taxes on IRC activities—through royalties, processing requirements, export restrictions, or simply institutional barriers to market access. The North thus has free access for international IRCs, but the South is less open for IRCs. Both explicit taxes and implicit institutional barriers raise the effective cost of critical mineral exploration in the South.

We illustrate these issues and derive various hypotheses regarding implicit critical mineral taxes or export bans for critical minerals in the South on exploration and investment in the South using a simple two-region, two-period model of global resource markets.

3.1. A Two-Region, Two-Period Model of Global Discovery of Critical Minerals

We focus on three periods (0 and 1) and two regions (North and South). In period 0 only exploration investment takes place, which leads to discoveries in the next period. Extraction does not occur in period 0, and in period 1 there is no exploration investment. IRCs in the North thus decide on exploration investment in period 0, denoted by e_0. This gives discoveries and reserves or supply of critical minerals in the next period, $S_1(e_0) = A\ln(e_0)$ with $A > 0$ an exogenous discovery productivity parameter.

Critical minerals are sold on the world market at price p_1 in period 1. The global resource market is competitive, so that IRCs take this price as given. The cost of extracting one unit of critical minerals is assumed to be constant and equal to $\gamma \geq 0$. There is a global capital market in which IRCs can freely borrow at the given world interest rate r.

Variables and discovery functions for the South are denoted by an asterisk. North and South may differ in extraction costs and initial reserves. Furthermore, the South has access restrictions captured by explicit or implicit taxes on exploration investment in period 0, denoted by τ^*. We could also model taxes on exports of minerals or an export ban, but the qualitative results would not be different. IRCs maximize the net worth of their activities in both the North and the South, so that they choose exploration investments e_0 and e_0^* to maximize $(p_1 - \gamma)S_1(e_0) + (p_1 - \gamma^*)S_1^*(e_0^*) - (1 + r)[e_0 + (1 + \tau^*)e_0^*]$. This yields the optimality conditions

$$(1) \qquad (p_1 - \gamma)S_1'(e_0) = 1 + r \quad \text{and} \quad (p_1 - \gamma^*)S_1^{*\prime}(e_0^*) = (1 + r)(1 + \tau^*).$$

Maximizing net worth of the IRCs thus requires that the marginal rent from discovery investment equals the full cost of that discovery including taxes in the South and interest. Using the discovery functions, we can rewrite equation (1) as

$$(1') \qquad p_1 = \gamma + (1 + r)\frac{A}{e_0} = \gamma^* + (1 + r)(1 + \tau^*)\frac{A^*}{e_0^*},$$

so that ICRs are indifferent between producing in the North and the South. IRCs thus arbitrage exploration opportunities across regions until the total marginal cost of extracting and discovering a unit of resource is equalized globally. This global arbitrage condition is the central mechanism through which policy in one region affects exploration outcomes in both.

Finally, global supply must equal global demand for critical minerals, where the latter equals $D_1(p_1)$ decreases in the global critical mineral price. We assume demand is iso-elastic, so that $D_1(p_1) = \Gamma p_1^{-\varepsilon}$, where $\varepsilon > 0$ denotes the price elasticity of demand and $\Gamma > 0$ denotes an exogenous shift to critical mineral demand. Market equilibrium on the world critical mineral market requires that global supply equals global demand for critical minerals, so

(2) $$S_1(e_0) + S_1^*(e_0^*) = D(p_1).$$

These market-clearing conditions gives the critical mineral price p_1.

The model consists of the three equations specified in (1) and (2), which can be solved for $\{e_0, e_0^*, p_1\}$ as function of the exogenous variables and parameters $\{\tau^*, A, A^*, \gamma, \gamma^*, \Gamma, r\}$.

3.1. Solution

To make the solution less cumbersome, we assume that $\gamma = \gamma^*$. In that case, equations (1) or equation (1') together with the discovery functions yield the arbitrage equation

(3) $$e_0 = \frac{A}{A^*}\frac{1}{1+\tau^*}e_0^*.$$

Hence, exploration investment in the North rises in line with that in the South. If exploration productivity in the North is higher than in the South ($\frac{A}{A^*} > 1$), exploration investment in the North is higher than in the South. If the South has explicit or implicit taxes on critical mineral exploration ($\tau^* > 0$), relatively more exploration takes place in the South than in the North.

Upon substitution of (3) into equations (2), and using the discovery function, we obtain

(4) $$(p_1 - \gamma)A^* = (1 + r)(1 + \tau^*)e_0^* \quad \text{and} \quad S_1\left(\frac{A}{A^*}\frac{1}{1+\tau^*}e_0^*\right) + S_1^*(e_0^*) = D(p_1).$$

These two equations can be solved for $\{e_0^*, p_1\}$ in terms of $\{\tau^*, A, A^*, \gamma, \Gamma, r\}$. In Figure 2 we show the first equation as an upwards-sloping curve corresponding to the supply curve for the South, denoted by SS. The supply curve SS shifts out if the unit extraction cost, the world interest rate, or explicit or implicit exploration taxes in the South increase (higher γ, r or τ^*) but shifts upwards if exploration productivity in the South increases (higher A^*). In Figure 2 we also show the second equation as a downwards-sloping curve corresponding to the conditions for global equilibrium on the global market for critical minerals, denoted by GM. The GM curve shifts out if exploration productivity in the South increases or that in the North decreases (higher A^*, lower A). Furthermore, the GM curve shifts out if the South levies explicit or implicit taxes on the export of critical minerals (higher τ^*).

3.2. Comparative statics results

We are now ready to discuss the comparative statics results. A higher world interest rate or a higher unit extraction cost (higher r or γ) only shifts out the SS curve, so we see from Figure 2 that in the new equilibrium exploration investment in the two regions falls and the world price of critical minerals rises. An improvement in geological conditions in the North (higher A) or a reduction in global demand for critical minerals (lower Γ) only shifts back the GM curve, hence both critical mineral investment in the South and the world price of critical minerals fall while critical mineral investment in the North rises. Better geological conditions in the South (higher A^*) cause an increase of mineral investment in the South and a drop in the North; the world price of critical minerals falls again. Finally, a tax on exploration investment or on the export of critical minerals from the South (higher τ^*), yields higher exploration investment and discoveries in the North but lower in the South; the world price of critical minerals typically increases unless extraction costs are a very concave function of reserves (see Appendix A). The point is that the rise in the critical mineral price due to the tax may be offset somewhat by the reduction in the price needed to clear the global market for critical minerals.

We can summarize these comparative statics results as follows:

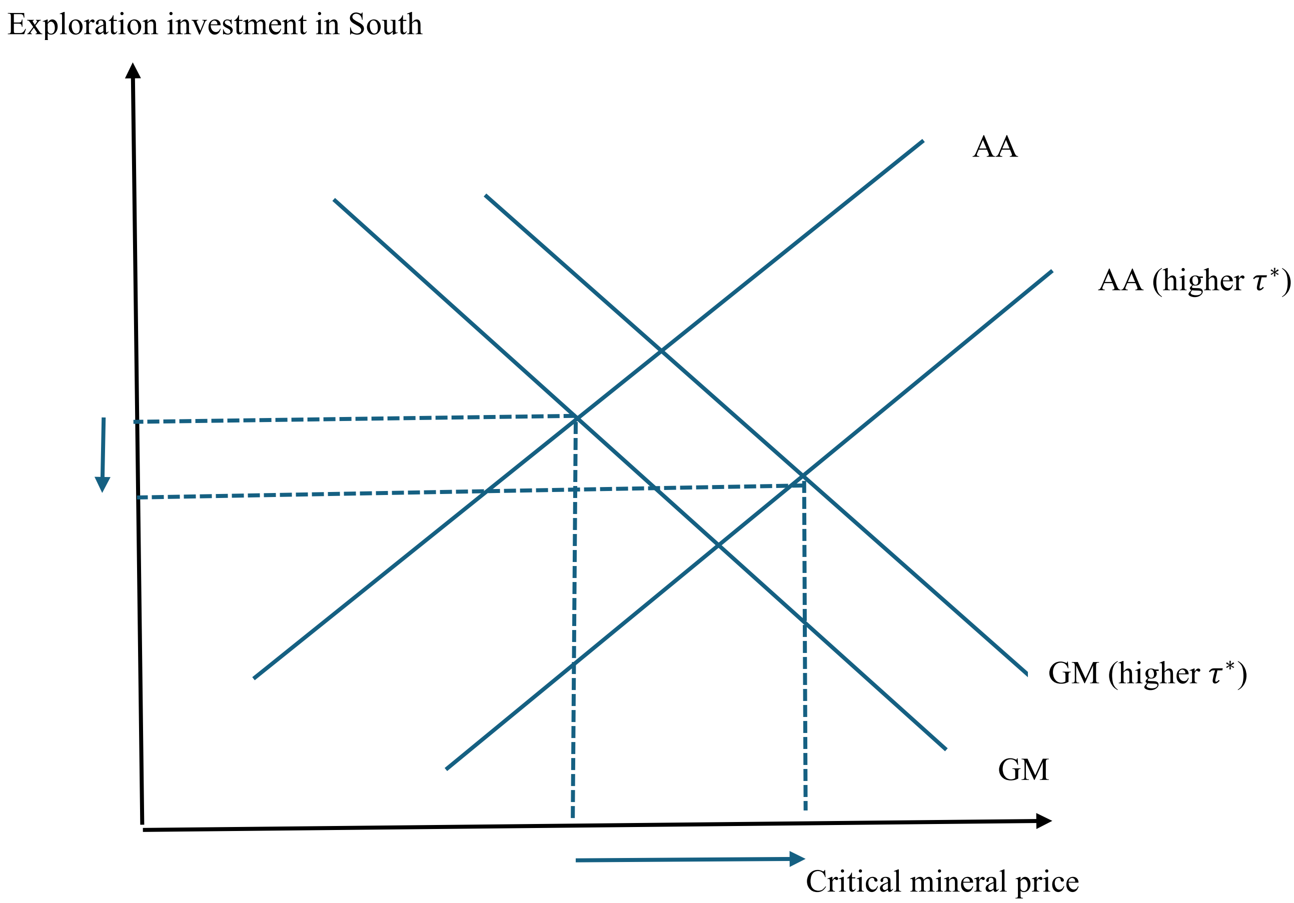
(5) $e_0 = I_0\left(\overset{-}{r}, \overset{-}{\gamma}, \overset{+}{A}, \overset{-}{A^*}, \overset{-}{\Gamma}, \overset{-}{\tau^*}\right)$, $\quad e_0^* = e_0^*\left(\overset{-}{r}, \overset{-}{\gamma}, \overset{-}{A}, \overset{+}{A^*}, \overset{+}{\Gamma}, \overset{+}{\tau^*}\right)$, and $p_1 =$

$p_1\left(\overset{+}{r}, \overset{+}{\gamma}, \overset{-}{A}, \overset{-}{A^*}, \overset{+}{\Gamma}, \overset{(+)}{\tau^*}\right)$,

where the pluses and minuses indicate the signs of the partial derivatives.

The North thus has more discoveries if geological conditions are better, it has a higher or more easily accessible stock of reserves, and there is easier access for IRCs in the North. The South has more discoveries if geological conditions are better, extraction is cheaper, and there are fewer restrictions on the export of critical minerals. Crucially, a higher tax on IRCs or export bans on critical minerals in the South thus hold back discoveries of critical mineral reserves in the South. The world price of critical minerals is high if the cost of borrowing is high, extraction costs are high, the productivity of discoveries is low, global demand for critical minerals is high, and typically if there are taxes or export bans on the sale of critical minerals from the South.

Figure 2: Exploration Investment and the Price of Critical Minerals



Other (not mutually exclusive) forces include the rise in global demand for critical minerals (e.g. from China and India) that led to more exploration efforts and discoveries and increases in the marginal cost of exploration. Taxes and export bans in the South lead to a shifting of exploration activities and discoveries from the South to the North, because these policies cause a rise in world resource prices. If the South drops its exploration tax for IRCs or its export ban on critical minerals, the world price of critical minerals falls, and exploration activities and discoveries shift from the North to the South.

We can thus distinguish three channels.

(i) Demand channel: A demand shock from, say, the acceleration of the energy transition raises the marginal value of undiscovered reserves and stimulates exploration globally.

(ii) Geological conditions: Better geology—lower extraction costs, more accessible subsoil resources—attracts more exploration investment and generates higher discovery rates globally.

(iii) Policy and institutional channel: Higher taxes on IRCs or less outward orientation in the South—including export bans, processing mandates, or arbitrary administrative barriers—hold back discoveries in the South and divert exploration investment to the North. The global arbitrage condition ensures that a policy tightening in the South raises the world price of the resource and shifts the frontier of discoveries northwards.

These predictions extend the hydrocarbon context of Arezki, van der Ploeg, and Toscani (2019) to critical minerals. The empirical evidence shows that increased market orientation causes a significant increase in natural resource discoveries, with Latin America and sub-Saharan Africa achieving only a quarter of their actual post-1990 discoveries had they remained closed— and is directly relevant. For critical minerals, which are disproportionately concentrated in developing countries with more volatile institutional environments, the policy channel is likely even more important.

3.3. Extension: dynamics of discoveries and resource extraction

We can extend the analysis of critical mineral discoveries to allow for three periods and extraction costs falling with remaining proved reserves, reflecting the lower cost of accessing abundant deposits (see Appendix B). In period 0 only exploration investment takes place and in period 2 all the resource is sold. This extension builds on the model of Pindyck (1978) and allows for the Hotelling rules for resource depletion as well as the optimal exploration investments and the arbitrage of IRCs across the globe. This framework allows one to investigate the effects of technology shocks, anticipated demand shocks, and anticipated and temporary restrictions on exploration investment in the South.

A global increase in exploration productivity (higher A and A^*) leads to less exploration investments in periods 0 and 1, but due to the higher productivity to higher extraction rates in period 1 and 2. World prices of critical minerals fall. An anticipated increase in demand for critical minerals in period 2, perhaps driven by the green transition, leads to bigger exploration investments and discoveries in periods 0 and 1, less extraction in period 1, and higher extraction in period 2. World prices of critical minerals now increase.

A *permanent* restriction in access to exploration in the South increases exploration investment in the North and decreases it in the South, in both periods 0 and 1. As a result, discoveries and thus extraction rates are cut back in the South but increased in the North. World prices for critical minerals fall. A *temporary* restriction on exploration investment cuts exploration in the South but increases it in the future. We thus have that extraction in the South falls substantially but less so in the future when the restriction is lifted. Prices of critical minerals thus increase but less so after the restriction. An *anticipated* restriction in access to exploration leads to a big drop in future exploration and discoveries in the South, but in anticipation a small increase in exploration before. Extraction falls but in the future it rises. World prices of critical minerals rise.

4. The Endogeneity of Critical Mineral Maps

The model clarifies a point that is often obscured in policy discussions: the maps that guide strategic assessments of critical mineral supply—published by the USGS, the IEA, and national geological surveys—represent the distribution of known resources, not the distribution of resources. The gap between the two is large and systematically related to the history of exploration investment.

Consider the distribution of lithium. The "Lithium Triangle" of Argentina, Bolivia, and Chile—accounting for a large share of known reserves—is a product of decades of targeted exploration investment. Bolivia's lithium resources remained largely outside the bankable resource base for many years not because the geology was unfavourable but because the investment climate was inhospitable. As institutions improved and state policies accommodated foreign investment, the known resource base expanded. Conversely, regions with favourable geology but hostile investment climates (many parts of sub-Saharan Africa, for instance) remain underexplored and therefore underrepresented on resource maps.

The endogeneity of known resources has two important implications for the current critical minerals debate. First, projections of long-run scarcity based on current reserve-to-production ratios are likely to be biased upward, since they treat the current map as the permanent map. Historical experience with oil and gas, where proved reserve estimates have consistently increased over time as exploration responds to price signals and institutional improvement, suggests that the critical mineral resource base is similarly extensible. Second, and more immediately relevant for policy, the institutional environment facing IRCs today determines tomorrow's resource map. Policies that deter exploration investment—including export bans—reshape the future geography of known resources.

From the model's global arbitrage condition, a tightening of access conditions in the South—the locus of most critical mineral deposits—does not simply reduce global supply; it shifts exploration northward and to alternative geologies, including deep-sea mining and recycling-intensive urban mining in advanced economies. The substitution is imperfect in the short run but becomes increasingly real as prices rise in response to the supply squeeze. The developing country imposing the export ban thus exports not just less ore but also, over time, it reduces exploration investment. In the long run, the ban may reduce the country's discovered resource base relative to the counterfactual in which it remained open.

5. The Self-Defeating Logic of Export Bans

The case for export bans on critical minerals rests on the logic of infant-industry protection: by denying foreign buyers access to cheap raw ore, the host government compels investment in domestic processing, creating downstream industries and higher-value employment. Indonesia's nickel success—in attracting nickel smelting investment from Chinese companies following its 2020 export ban—is frequently cited as proof of concept.

Yet, the analysis above reveals a critical weakness in this reasoning: it ignores the upstream investment response. An export ban changes the expected return profile of mining operations in the country. IRCs that previously anticipated revenues from exporting ore must now either participate in domestic processing—an activity requiring different capital, technology, and supply-chain relationships—or forgo operations in that country. For exploration activity, which generates returns only if the resulting ore can be profitably sold, this is an especially sharp constraint. An IRC considering whether to invest in exploration in a country with an export ban on unprocessed ore faces uncertainty about whether the processing infrastructure required to monetize any discovery will exist, be cost-competitive, or remain under terms that allow adequate returns on the exploration investment.

The model predicts that this effect will be most pronounced for frontier exploration—precisely the kind that extends the resource map into new territories and geological formations. Near-surface deposits in established mining districts with existing processing infrastructure are less sensitive to export bans than greenfield exploration in untested areas. To the extent that developing countries' strategic interest lies in demonstrating the existence and commerciality of undiscovered deposits, export bans may thus be most costly along the dimension that matters most for long-run development.

A secondary self-defeating effect operates through resource prices. If export restrictions in several major producing countries simultaneously reduce the supply of critical minerals on world markets, prices will rise. In the short run, this benefits the restricting countries through higher unit revenues on the ore they export. But higher prices also stimulate alternative supply development—exploration in other jurisdictions, substitution toward alternative materials, and acceleration of recycling—which erodes the market power that justified the ban in the first place. The DRC's experience with its 2025 cobalt export ban is instructive: the ban was motivated partly by falling cobalt prices driven by oversupply, but the announcement itself prompted accelerated investment in cobalt-free battery chemistries by major automakers, compounding the long-run demand risk.

This does not mean that all forms of value-chain policy are self-defeating. The relevant distinction is between policies that affect the terms on which ore is sold after extraction—which leave exploration incentives largely intact—and policies that constrain what can be done with ore before it is sold, raising the effective barrier to entry for exploration investment. Royalty regimes, domestic content requirements in processing contracts, and state equity participation can, if well-designed, capture value without fundamentally altering exploration incentives. Export bans on unprocessed ore, by contrast, directly affect the expected return to discovering ore in the first place.

The dualism of institutional requirements highlighted by Arezki and van der Ploeg (2025) is illuminating here. Successful mineral-rich development requires both outward-facing institutions—openness, rule of law for investors, contract enforcement—that attract foreign exploration capital, and inward-facing institutions—state capacity, revenue management, local content—that translate mineral revenues into development. Export bans represent a particular institutional choice that prioritizes downstream industrial policy at the expense of upstream investment attractiveness. Countries with strong state capacity to build domestic processing industries and negotiate technology transfer may sustain this trade-off. For most less-developed mineral-rich countries, however, the institutional preconditions for a successful export ban strategy do not exist, and the upstream costs are likely to dominate.

6. Conclusion

The global discourse on critical minerals is dominated by concern over scarcity of a fixed resource base. This paper argues that such a framing is misleading: the known resource base is endogenous to demand, prices, and institutional conditions. Using a two-region model of exploration investment by internationally mobile resource companies, we show that discovered reserves respond positively to world demand and prices, and negatively to taxes and institutional barriers, including, crucially, export bans and processing mandates.

The proliferation of export restrictions on critical minerals by resource-rich developing countries—documented in this paper across cobalt, lithium, nickel, rare earths, and other strategic minerals—represents a wave of institutional tightening that, according to our model, will tend to reduce exploration investment in the South and shift the frontier of mineral discovery northward or toward alternative geologies. The countries most in need of leveraging their mineral wealth for structural transformation may thus be eroding the upstream investment that makes such leverage possible.

The policy implication is not that developing countries should forgo industrial policy ambitions for their mineral sectors. It is rather that the design of value-chain policy must account for the upstream investment response. Policies that raise the effective barrier to exploration—rather than merely capturing a share of the rent from exploration already undertaken—risk being self-defeating. Institutional frameworks that maintain openness for exploration while building state capacity to capture and manage downstream value are more likely to deliver the development dividends that export bans promise but may not deliver.

More broadly, the endogeneity of the resource base implies that the critical minerals map of 2040 will be substantially determined by the institutional choices made today. Countries that maintain open, predictable, and well-regulated environments for exploration investment will tend to see their known resource bases expand with demand. Countries that treat their current geological endowment as leverage for extraction of downstream concessions may find that endowment shrinking in discovered terms, as investment shifts elsewhere. In a world racing to secure critical mineral supply, the institutional geography of the investment climate may ultimately matter as much as the physical geography of the deposits.

References

African Climate Wire (2026). "Export Restrictions on Critical Minerals: What Zimbabwe's Recent Ban Tells Us." April. Available at: africanclimatewire.org.

Al Jazeera (226). "Zimbabwe Imposes Ban on Exports of All Raw Minerals and Lithium Concentrate." February 25.

Anderson, S.T., Kellog, R. and Salant, S.W. (2018). "Hotelling under Pressure. " Journal of Political Economy, 126, 3: 984-1026.

Arezki, R. and van der Ploeg, F. (2023). "On the New Geopolitics of Critical Materials and the Green Transition." In C. Gollier and D. Rohner (eds.), Peace not Pollution. CEPR Press.

Arezki, R. and van der Ploeg, F. (2025a). "The Critical Minerals Curse." *Revue d'Economie du Développement*, Volume 33, pp. 127-142.

Arezki, R. and van der Ploeg, F. (2025b). *Escaping the Critical Mineral Curse. CEPR Policy Insight 147,* July.

Arezki, R., van der Ploeg, F. and Toscani, F. (2019). "The Shifting Natural Wealth of Nations: The Role of Market Orientation." Journal of Development Economics, 138: 228–245.

Arrow, K.J. and Chang, S. (1982). "Optimal Pricing, Use and Exploration of Uncertain Natural Resource Stocks." Journal of Environmental Economics and Management, 9(1): 1–10.

Benchmark Mineral Intelligence (2026). "Zimbabwe Suspends Lithium Concentrate Exports." February 25. Available at: source.benchmarkminerals.com.

Boschini, A., Pettersson, J. and Roine, J. (2007). "Resource Curse or Not: A Question of Appropriability." Scandinavian Journal of Economics, 109(3): 593–617.

Bosker, M., van den Herik, E.-M., Pelzl, P. and Poelhekke, S. (2025). "The (Unintended) Consequences of Export Restrictions: Evidence from Indonesia." DP20791, CEPR, London.

Devarajan, S. and Fisher, A.C. (1982). "Exploration and Scarcity." Journal of Political Economy, 90(6): 1279–1290.

Frankel, J. (2012). "The Natural Resource Curse: A Survey of Diagnoses and Some Prescriptions." In R. Arezki, C. Pattillo, M. Quintyn, and M. Zhu (eds.), Commodity Price Volatility and Inclusive Growth in Low-Income Countries. IMF.

Global Trade Alert (2025). "Chinese Export Controls on Critical Raw Materials: Inventory." October 8. Available at: globaltradealert.org.

Global Trade Alert (2022). "Zimbabwe: Export Ban on Unprocessed Lithium." State Act No. 71304. Available at: globaltradealert.org.

IEA (2025). *Global Critical Minerals Outlook 2025*. Paris: International Energy Agency.

IEA Policies Database (2023). "Export Ban on Raw Materials — Namibia." Policy No. 28970. Available at: iea.org/policies.

Kirk, J., Passari, E. and Rey, H. (2026). "Exorbitant Privilege of the Periodic Table? Geoeconomics, Endogenous Centrality and Strategic Minerals for the Green Transition. " Working Paper 35497, NBER, Mass.

McCarthy Tétrault (2026). "Zimbabwe's Lithium Export Ban." *Mondaq*, April. Available at: mondaq.com.

Mehlum, H., Moene, K. and Torvik, R. (2006). "Institutions and the Resource Curse." Economic Journal, 116(508): 1–20.

Mining Weekly (2023). "Namibia Bans Export of Unprocessed Critical Minerals." June 9. Available at: miningweekly.com.

OECD (2025). *Inventory of Export Restrictions on Industrial Raw Materials 2025*. Paris: OECD Publishing. https://doi.org/10.1787/facc714b-en.

Pindyck, R.S. (1978). "The Optimal Exploration and Production of Nonrenewable Resources." Journal of Political Economy, 86(5): 841–861.

Ross, M. (2012). The Oil Curse: How Petroleum Wealth Shapes the Development of Nations. Princeton University Press.

S&P Global Market Intelligence (2023). "Indonesia to Ban Exports of Bauxite, Tin, Cobalt — Resources Minister." April 18.

The Diplomat (2022). "Indonesia to Ban Exports of Bauxite from June 2023." December 22. Available at: thediplomat.com.

van der Ploeg, F. (2011). "Natural Resources: Curse or Blessing?" Journal of Economic Literature, 49(2): 366–420.

Venables, A.J. (2016). "Using Natural Resources for Development: Why Has It Proven So Difficult?" Journal of Economic Perspectives, 30(1): 161–184.

Table 1: Selected Critical Mineral Export Restrictions, 2020–2026

Measures restricting the export of unprocessed or raw critical minerals intended to promote domestic value addition and industrial development

Region	Country	Mineral(s) Affected	Date	Nature of Restriction / Measure	Stated Rationale
Southeast Asia	Indonesia	Nickel ore	Jan 2020 (reimposed; first ban 2014)	Full export ban on unprocessed nickel ore. Earlier 2014 ban had been partially relaxed in 2017.	Force domestic smelting investment; capture EV battery value chain. President Widodo: 'add value domestically to open jobs and increase foreign exchange.'
Southeast Asia	Indonesia	Bauxite ore	Jun 2023 (announced Dec 2022)	Full export ban on unprocessed bauxite ore, requiring domestic alumina refining before export.	Replicate nickel success; develop domestic aluminium refining industry. Estimated to increase state revenue from Rp 21 trillion to Rp 62 trillion.
Southeast Asia	Indonesia	Tin, cobalt	Jun 2023 (announced Apr 2023)	Ban on export of unprocessed tin and cobalt ore, part of broader down-streaming strategy under Mining Law.	Part of systematic down-streaming of all mineral exports mandated by Indonesia's 2009 Mining Law.
Latin America	Mexico	Lithium	Apr 2022	Nationalisation: law declared lithium a strategic national resource; state-owned company LitioMx established to oversee all lithium exploration, extraction and refining. Foreign concessions frozen.	Prevent foreign exploitation: 'We will not allow foreigners to exploit lithium' (President AMLO). Control strategic mineral for energy transition.
Latin America	Chile	Lithium	Apr 2023	National Lithium Strategy: all future lithium extraction to involve state majority stake via Codelco/ENAMI; new private concessions require public-private partnerships with state control throughout value chain.	Capture value along entire lithium cycle; link economic development to green economy. Not outright export ban but mandatory state participation constraining foreign investor terms.
Latin America	Bolivia	Lithium	Ongoing (state monopoly since 2008)	State monopoly via Yacimientos de Litio Bolivianos (YLB); private investment restricted; limited export of processed lithium only.	Sovereign control of 'strategic resource'; industrialize domestically. Foreign investment permitted only under strict state-control frameworks.
Africa (Southern)	Zimbabwe	Lithium ore (unprocessed)	Dec 2022 (Statutory Instrument 213/2022)	Ban on export of all unbeneficiated lithium-bearing ores. Export of lithium concentrates initially still permitted (with minimum lithia content threshold added in 2023).	Retain mineral value domestically; prevent smuggling and revenue loss; attract processing investment. First African country to impose such a ban (IEA).
Africa (Southern)	Zimbabwe	Lithium concentrate + all raw minerals	Feb 2026 (25 Feb 2026, indefinite)	Expanded ban: suspended exports of ALL raw minerals and lithium concentrates including material already in transit, with immediate effect, until further notice.	Crack down on malpractice, unauthorized exports, and 'leakage'; accelerate domestic refining now that some Chinese-backed processing plants are nearing completion (Huayou Cobalt, Sinomine).

Region	Country	Mineral(s) Affected	Date	Nature of Restriction / Measure	Stated Rationale
Africa (Southern)	Namibia	Lithium, cobalt, manganese, graphite, rare earths (dysprosium, terbium)	Jun 2023 (Cabinet, 6 Jun 2023)	Ban on export of unprocessed crushed lithium ore, cobalt, manganese, graphite, and rare earth elements. Small quantities may be exported with ministerial approval.	Capture value from battery-metals boom; create local processing jobs; aligned with Mineral Beneficiation Strategy 2021–2030. Triggered EU concern 8 months after Namibia-EU rare earths MoU.
Africa (West)	Ghana	Lithium, bauxite, iron ore, other 'green minerals'	Jul 2023 (Green Minerals Policy, Cabinet 27 Jul 2023)	Green Minerals Policy prohibits export of raw lithium and other green minerals. Feb 2024: President announced additional prohibition on raw bauxite export and construction of manganese refinery.	Retain 'significant proportion of value chain' domestically; avoid repeating gold-sector pattern of raw export with little domestic benefit. Policy explicitly modelled on Zimbabwe/Namibia precedents.
Africa (East)	Tanzania	Lithium	May 2024 (announced Nov 2023)	Minerals Ministry directed all lithium miners to add value domestically before export; ban on export of unrefined lithium effective May 2024.	Move up value chain; require beneficiation in-country as condition of operating licence.
Africa (East)	Malawi	All unprocessed minerals (uranium, rare earths, graphite, rutile)	Oct 2025 (announced Oct 2025; reinforced Feb 2026)	Ban on export of all unprocessed raw minerals. Feb 2026: suspension of new mining licence issuance alongside export ban, pending audit and sector reset.	Maximize fiscal returns and employment; leverage rare earth and graphite deposits for development. President Mutharika: country 'can earn up to $500 million annually' if minerals processed locally.
Africa (Central)	DRC (Dem. Rep. of Congo)	Cobalt	Feb 2025 (4-month suspension, then quota from Oct 2025)	Four-month export suspension of cobalt imposed February 2025 to arrest falling prices; replaced in October 2025 by quota management regime. President warned of 'exemplary sanctions' for violations.	Arrest collapsing cobalt prices driven by oversupply; prevent stockpiling by China; assert state control over strategic resource. DRC produces ~70% of global cobalt.
Asia (China)	China	Rare earth extraction & separation technology	Dec 2023	Export ban on technology and know-how for rare earth extraction, separation, and smelting — extending controls beyond physical minerals to process knowledge.	National security; prevent global competitors from replicating Chinese processing dominance even with alternative ore sources.
Asia (China)	China	Gallium, germanium	Aug 2023 (licensing); Dec 2024 (ban to US)	Aug 2023: export licensing requirements for gallium and germanium. Dec 2024: outright export prohibition to United States (gallium, germanium, antimony, superhard materials).	National security; retaliation for US semiconductor export controls. Gallium prices reached record highs; antimony exports to US fell ~97%.
Asia (China)	China	High-purity graphite	Oct 2023 (licensing, effective Dec 2023)	Export licensing/permit requirements for certain graphite products (battery-grade). End-user and end-use reviews for US-destined shipments tightened Dec 2024.	National security; leverage dominance in graphite processing (~70% of battery-grade supply) amid EV supply-chain competition.
Asia (China)	China	Antimony, superhard materials	Sep 2024	Export restrictions on antimony (used in ammunition, infrared sensors, flame retardants) and superhard materials, tightened to near-prohibition for US in Dec 2024.	National security; strategic leverage. Antimony prices roughly doubled following announcement.

Region	Country	Mineral(s) Affected	Date	Nature of Restriction / Measure	Stated Rationale
Asia (China)	China	Tungsten, tellurium, bismuth, indium, molybdenum	Feb 2025	Export licensing controls on five additional critical minerals with key semiconductor, clean energy, and defence applications.	Escalating geopolitical competition; tit-for-tat with US technology export controls.
Asia (China)	China	Medium and heavy rare earths (samarium, gadolinium, terbium, dysprosium, lutetium, scandium, yttrium)	Apr 2025	Export controls on seven rare earth elements critical for EV magnets, wind turbines, and defence electronics. Followed by Oct 2025 expansion adding five more elements (holmium, erbium, thulium, europium, ytterbium) and extraterritorial 50% re-export rule.	Strategic leverage over green-transition supply chains; respond to US tariffs. Suspension negotiated in Trump-Xi trade truce (Oct 2025) for one year while broader controls remain.
Notes	Multiple (13+ African countries per African Climate Wire, 2026)	Various	2019–2026	OECD (2025): export restrictions on ores and minerals increased nearly tenfold 2009–2023; ~16% of global critical raw material trade faced at least one export restriction in 2022–2024 (up from ~12% in 2009–2011). Cobalt and manganese most affected (67–70% of trade). Export bans and quantitative restrictions have risen sharply since 2019.	Revenue generation now fastest-growing stated rationale (OECD 2025); industrial policy second. Five countries (India, China, Argentina, Vietnam, Burundi) accounted for >50% of new measures 2009–2024.

Sources: Authors' compilation from national government announcements, press reports, and regulatory filings, including Global Trade Alert, the IEA Policies Database, OECD (2025), S&P Global Market Intelligence, Mining Weekly, The Diplomat (2022), Al Jazeera, Benchmark Mineral Intelligence, African Climate Wire, and Mondaq (2026). Aggregate statistics on the global incidence of export restrictions are from OECD, Inventory of Export Restrictions on Industrial Raw Materials 2025.

Appendix A: Effects of a Tax on Mineral Exports

Totally differentiating the two equations in (4) around a symmetric equilibrium with $\tau^* = 0$, we obtain the system of equations

(B1) $$\begin{pmatrix} 2S' & -D' \\ p'S'' & S' \end{pmatrix} \begin{pmatrix} de_0^* \\ dp_1 \end{pmatrix} = \begin{pmatrix} -e_0^* S' \\ 1+r \end{pmatrix} d\tau^*$$

Using $\det = 2(S')^2 + p_1 D' S D'' < 0$ in Cramer's Rule gives

(B2) $$\frac{de_0^*}{d\tau^*} = \frac{\begin{pmatrix} -e_0^* & -D' \\ 1+r & S' \end{pmatrix}}{\det} = \frac{(1+r)D' - e_0^* S'}{\det} < 0 \text{ and } \frac{dp_1}{d\tau^*} = \frac{\begin{pmatrix} 2S' & -e_0^* S' \\ p'S'' & 1+r \end{pmatrix}}{\det} = \frac{2(1+r) + e_0^* p_1 S''}{\det} S' > 0.$$

An exploration tax in the South always diminishes investment exploration in the South as $D' < 0$ and $S' > 0$. However, the effect of an export ban on the world mineral price is ambiguous but is positive if $-e_0^* p_1 S'' > 2(1+r)$.

Appendix B: A Two-Region, Three-Period Model of Mineral Discoveries

We focus on three periods (0, 1 and 2). In period 0 only exploration investment takes place, which leads to discoveries in period 1. There is no extraction in period 0 and no exploration investment in period 2. IRCs decide on exploration investment in periods 0 and 1, e_0 and e_1. This gives initial reserves, $S_1(e_0)$, and discovery of new reserves in period 1, $N(e_1) = A\ln(e_1)$. At the start of period 2, reserves in the North equal initial reserves plus discoveries minus extraction in period 1, $S_2 = S_1(e_0) + N(e_1) - R_1$, where R_1 denotes current extraction. Future extraction cannot exceed remaining reserves, so $R_2 \leq S_2$ must hold.

Critical minerals are sold on a competitive world market at prices p_1 and p_2 in periods 1 and 2, respectively. The cost of extracting one unit of reserves falls with remaining proven reserves, reflecting the lower cost of accessing abundant deposits, captured by $G(S_t) = \omega / S_t$ with $\omega > 0$. The South has explicit or implicit exploration taxes τ_0^* and τ_1^* in periods 0 and 1, respectively. IRCs maximize their net worth and choose exploration investments and extraction rates to solve

(B1)
$$\underset{e_t, e_t^*, R_t, R_t^*}{\text{Max}} \sum_{t=1}^{2} ((1+r)^{-t}[p_t - G(S_t)]R_t - (1+r)^{t-1}e_{t-1}) +$$
$$\sum_{t=1}^{2} ((1+r)^{-t}[p_t - G^*(S_t^*)]R_t - (1+r)^{t-1}(1+\tau_{t-1}^*)e_{t-1}),$$

subject to the resource depletion constraints in the North and the South,

(B2) $R_2 \leq S_2 = S_1(e_0) + N(e_1) - R_1$ and $R_2^* \leq S_2^* = S_1^*(e_0^*) + N^*(e_1^*) - R_1^*$.

Finally, global supply must equal global demand for critical minerals in periods 1 and 2, so

(B3) $R_1 + R_1^* = D(p_1)$ and $R_2 + R_2^* = D(p_2)$.

B.1. Equilibrium conditions

Hotelling rules: The solution to (B1)-(B2) gives the Hotelling rules governing extraction for the North and South, that is

(B4)
$$p_2 - G(S_2) + G'(S_2)R_2 = (1+r)[p_1 - G(S_1)] \quad \text{and}$$
$$p_2 - G^*(S_2^*) + G^{*\prime}(S_2^*)R_2^* = (1+r)[p_1 - G^*(S_1^*)].$$

In each region, future rents (i.e. price net of extraction cost) minus the marginal increase in future extraction cost from extracting an extra unit today must equal current rents plus accrued interest. These conditions equate the opportunity cost of production across time in each region and ensure that the price path for resources is consistent with exhaustibility.

Optimal exploration investments: Maximizing net worth of the IRCs also requires that the marginal rent from exploration investment in period 1 equals the full cost of that discovery including taxes in the South, so that

(B5) $[p_2 - G(S_2(e_1))]N'(e_1) = 1 + r$ and $[p_2 - G^*(S_2^*(e_1^*))]N^{*\prime}(e_1^*) = (1+\tau_1^*)(1 + r)$.

Maximizing net worth also gives the efficiency conditions for investment in period 0, i.e.

(B6)
$$\left[p_1 - G\big(S_1(e_0)\big) - G'\big(S_1(e_0)\big)R_1 - \frac{G'(R_2)R_2}{1+r}\right] S_1'(e_0) = 1 + r \text{ and}$$
$$\left[p_1 - G^*\big(S_1^*(e_0^*)\big) - G'\big(S_1^*(e_0^*)\big)R_1^* - \frac{G'(R_2^*)R_2^*}{1+r}\right] S_1^{*\prime}(e_0^*) = (1+\tau_0^*)(1+r).$$

Hence, initial exploration investments in period 0 benefit from making future extraction cheaper in both periods 1 and 2 by ensuring higher proved reserves.

B.2. Solution

The two depletion equations of reserves in period 2 in (B2), the two Hotelling rules (B4), the four optimality conditions for optimal exploration investment (B5) and (B6), and the two equations (B3) for equilibrium in the world market for critical minerals can be solved for the ten endogenous variables $\{e_0, e_0^*, e_1, e_1^*, R_1, R_1^*, R_2 = S_2, R_2^* = S_2^*, p_1, p_2\}$ in terms of the exogenous variables $\{A, A^*, \omega, \omega^*, \Gamma_1, \Gamma_2, \tau_0^*, \tau_1^*\}$.

We can solve this system of nonlinear equations using the demand curves $D(p_t) = \Gamma_t p_t^{-\epsilon}$, $t = 1,2$, the extraction cost functions $G(S_t) = \omega/S_t$, $t = 1,2$, and the discovery functions $S_1 = A\ \ln(e_0)$ and $N(e_1) = A\ \ln(e_1)$, and similarly for the South. Starting with a symmetric outcome ($A = A^* = 5, \omega = \omega^* = 0.01$, $\Gamma_1 = \Gamma_2 = 1$, $r = 0$, $\epsilon = 0.4$, and $\tau_0^* = \tau_1^* = 0$), we thus find the deviations from the benchmark for various policy experiments in the South reported in the Table B1 as percentages. We discuss these briefly in Section 3.3.

Table B1: Effects of a permanent, temporary, and anticipated exploration tax in the South (in percentages from the benchmark)

%	e_0	e_0^*	e_1	e_1^*	R_1	R_1^*	R_2	R_2^*	p_1	p_2
$A = A^* = 6$	-1.4	-1.4	-2.0	-2.0	8.3	8.3	8.1	8.1	-18.0	-18.0
$\Gamma_2 = 1.5$	3.6	3.6	4.5	4.5	-2.3	-2.3	48.3	48.3	5.9	2.8
$\tau_0^* = \tau_1^* = 0.1$	5.0	-5.4	5.2	-5.6	45.1	-48.7	34.8	-4.4	5.1	4.5
$\tau_0^* = 0.1$	2.2	-5.6	2.0	1.0	14.4	-16.3	45.4	-2.9	2.5	1.5
$\tau_1^* = 0.1$	2.8	1.1	2.5	-6.8	30.1	-31.7	13.6	-2.1	2.4	2.4

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner ? Sera-ce sur le caprice de chaque particulier ? Quelle confusion ! Sera-ce sur la justice ? Il l'ignore."

Pascal

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