

Beyond Nickel: Can the Jakarta Model Travel?

Conditions for Successful Mineral Downstreaming in the Global South

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Abstract: Indonesia's ban on unprocessed nickel ore exports is often cited as the first successful case among commodity-dependent economies in the Global South to upgrade its position within global value chains. Yet, it remains uncertain how replicable the "Jakarta Model" is. This paper evaluates under which conditions Global South countries can successfully use export controls and downstreaming to exert strategic agency in critical minerals value chains. A multimethod design is employed, combining process tracing with: (1) an event study of nickel price reactions to Indonesia's export ban announcements; (2) a quasi-experimental analysis of FDI flows in nickel processing, comparing Indonesia to a counterfactual "Synthetic Indonesia;" and (3) a trade composition analysis tracing the shift from ore exports to value-added products, along with changes in key import partners. The findings suggest that Indonesia's success in exercising strategic agency and forcing foreign investments hinged on market power, policy credibility, infrastructure readiness, and capital depth. A Downstreaming Readiness Index is introduced and applied to the Philippines, Zimbabwe, Namibia, and the DRC, revealing that none of these countries meets all the conditions necessary for geoeconomic agency. As such, this paper extends IPE debates on resource nationalism, global value chains, and geoeconomics while providing a transferable framework to assess the opportunities and constraints facing Global South actors in the critical mineral era.

Introduction: Can the Global South Move Markets?

After the 2008 global financial crisis, the neoliberal consensus on industrial policy started to erode, as countries increasingly sought to enhance their competitiveness and capture more domestic value. With the 2015 Paris Agreement further underscoring the relevance of critical raw materials in the energy and digital transitions,¹ a growing demand emerged from industrialised economies for the minerals used in low-carbon technologies, such as electric vehicle (EV) batteries and wind turbines, turning them into strategic assets for industrial upgrading in commodity-dependent economies.² Indonesia's nickel downstreaming strategy is often cited as the first success among these economies in upgrading its position within global value chains (GVCs). Nickel is a critical mineral indispensable to low-carbon technologies, primarily used in the production of stainless steel and lithium-ion batteries for EVs.³ Endowed with the world's largest reserve of nickel ore, Indonesia first introduced the export control of unprocessed nickel ore in 2014 to strengthen its domestic processing capacities.⁴ As the EV battery

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³ LLM use declaration: ChatGPT (web-based version, OpenAI) and Claude (web-based version, Anthropic) were used for grammar, spelling, and language clarity checks during editing and proofreading. No AI-generated content was directly incorporated into the manuscript. Cursoe (desktop version, Anysphere Inc) was used to refine and debug Python code for the quantitative analysis. All analytical logic and methodological decisions were authored and verified by the authors of the paper.

industry expanded, it imposed a complete ban in 2020, repurposing the export control as a tool of development.⁵ As a result, the export value of Indonesia's nickel derivative products increased nearly tenfold, from USD 4 billion in 2017 to an estimated USD 38-40 billion in 2024.^{6,7} Over the same period, Indonesia's nickel production increased dramatically (Figure 1), with its mined and refined output accounting for 64% and 43% of global nickel production, respectively, in 2024.^{8,9}

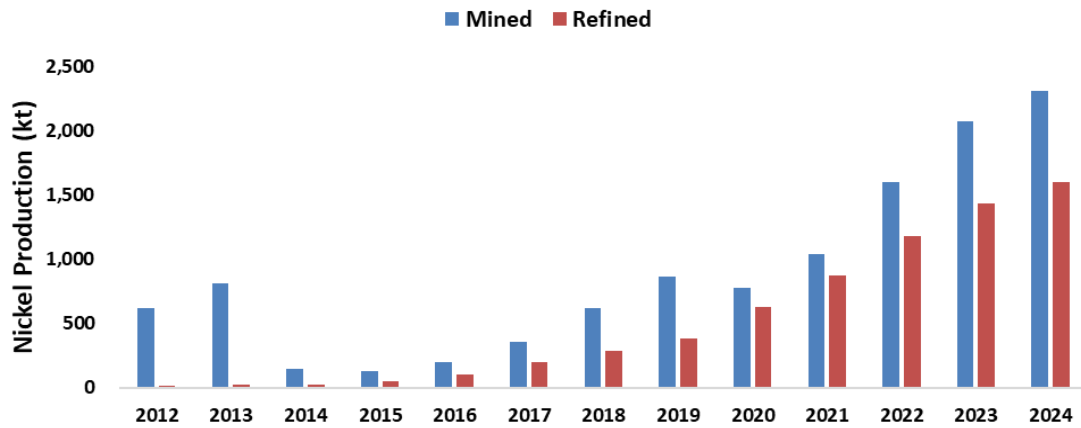


Figure 1. Indonesia's mined and refined nickel production (Source: WBMS)

Indonesia's nickel strategy has yielded geoeconomic gains; however, it has also faced strong contestation emanating from importing countries. The export ban announcements increased global nickel prices for a sustained period,¹⁰ triggering World Trade Organisation (WTO) disputes brought by both the European Union (EU) and the United States (US).¹¹ Nevertheless, Indonesia's approach has emerged as a model – often called the “Jakarta Model” – for other resource-rich countries which have considered or emulated it, including the Philippines, Zimbabwe, Namibia, and the Democratic Republic of the Congo (DRC).¹² Given these attempts at emulating Indonesia's industrial policy, it remains unclear why the country continues to be such an exceptional case. There are dozens of Global South countries that are endowed with comparable mineral resources and have long sought to move beyond simply exporting raw materials, yet the vast majority have failed to translate their resource wealth into industrial upgrading. Therefore, this paper asks under which conditions resource-rich low- and middle-income countries can deliberately move up GVCs and enhance their strategic agency.

Our core claim is that while such agency is possible, it can only be achieved under a set of structural conditions; namely, substantial market power in the relevant mineral, credible policy commitment, adequate infrastructure, and sufficient capital depth. The paper proceeds as follows. After reviewing the literature on industrial policy and resource nationalism, we outline our empirical strategy in Section 2. The results are presented in Section 3. We end this paper by introducing a Downstreaming Readiness Index, applying it to the four cases: the Philippines, Zimbabwe, Namibia, and the DRC. The conclusion discusses broader implications for geoeconomic agency in the Global South.

From Resource Nationalism to Geoeconomic Agency

Resource Nationalism and Industrial Upgrading

The growing strategic importance of critical minerals has rekindled resource nationalism, whereby states increasingly use export controls, local-content requirements, and nationalisations to capture greater rents from commodity exports and to boost their economic development. For decades, resource-rich emerging market and developing economies (EMDEs) remained concentrated at the bottom of the value chain, exporting raw ore or low-value intermediates that were processed into higher-value products abroad, especially in China.¹³ This commodity dependence often made these countries more vulnerable to sudden reductions or reversals in capital inflows (so-called “sudden stop”), leading to economic crises.¹⁴ Nevertheless, moving up the value chain is not straightforward, as each higher stage in the value chain requires additional capital investment, more advanced technology, and more complex regulations. The export ban on unprocessed minerals aims to address this challenge by conditioning access to raw materials on domestic processing. As such, it creates a trade-off for countries importing raw minerals to process them: either absorbing higher costs by seeking alternative suppliers or investing in smelting and refining capacity in exporting countries.¹⁵ Product space theory provides an explanation as to why such industrial upgrading is difficult, which highlights that diversification is path dependent. While countries tend to expand into “proximate” products that are close to their existing capabilities, moving into more distant and higher-complexity products is difficult without intentional capacity building.¹⁶ For resource-rich EMDEs, this signifies that moving from raw ore to more complex, processed intermediates requires distinct capabilities and deliberate policy intervention rather than simply restricting exports.¹⁷

Geoeconomic Global South

Across International Political Economy (IPE), there is increasing literature on how states “weaponize interdependence” to leverage global networks and exercise geoeconomic agency through sanctions, export controls, investment screening, and other economic instruments.¹⁸ Yet, most literature focuses on the Global North, especially the US and the EU, which possess asymmetric financial, technological, and trade networks for denying access and exercising economic coercion against rival states.^{19,20} While the rise of China, such as the Belt and Road Initiative (BRI), has received substantial attention in the geoeconomics literature, the Global South is often framed as an object of geoeconomic strategies rather than an originator.²¹ This is especially true for critical minerals, where developed countries extract minerals in the Global South with more relaxed regulations and gain most of the profits by dominating the value chain, including mineral processing and advanced technology manufacturing.²²

The swift transition from hydrocarbons to critical minerals has started to challenge this narrative, as mineral-producing states increasingly exercise strategic control over natural resource industries to boost domestic industrialisation. Over 20% of trade in certain critical minerals necessary for the green transition was subject to at least one export restriction between 2020 and 2023.²³ Resource-rich countries pursue twin goals in moving up global supply chains: domestic development and potentially gaining agency vis-à-vis importers. They might be attempting to escape a paradox, whereby their resources should give them geoeconomic power vis-à-vis importers, but their position in GVCs makes

them dependent on the processing capabilities of importing countries, and thus vulnerable to weaponized interdependence from the latter. For example, although Bolivia possesses one-fourth of the world's lithium resources, it has not been able to translate its 2008 nationalisation into bargaining power and has rather become entrenched in a dependency relationship with China.^{24,25}

While the literature reveals the resurgence of resource nationalism and the potential geoeconomic use of critical minerals, there is a lack of systematic explanation as to why outcomes diverge sharply. Although many resource-rich EMDEs have introduced export controls and domestic processing requirements, few have successfully leveraged these policies to achieve industrial upgrading. Existing studies have focused on the political drivers of resource nationalism and the governance risks it poses to investors, while often overlooking the structural conditions that determine whether export controls spur downstream capacity or simply disrupt trade. Moreover, Indonesia-focused research has examined some specific factors of its success, but the findings are rarely systematised within a transferable framework, and thus the question as to why Indonesia, but not other countries, has achieved success is still undertheorized. This paper fills this gap by elucidating the causal mechanisms for Indonesia's industrial upgrading and systematising these findings into a Downstreaming Readiness Index, identifying the conditions necessary for geoeconomic agency to be sustainable and replicable.

Research Design & Methods

Case Selection

This paper uses Indonesia as a “most likely” case for theory-building in mineral downstreaming because it offers clear and impactful policy measures, expansion of downstream capacity, and high relevance as a significant mineral supplier on the global scale. To understand if the mechanisms operate outside of Indonesia, this paper analyses four resource-rich EMDEs that have either adopted or seriously considered Indonesia-style downstreaming, namely the Philippines (nickel), Zimbabwe and Namibia (lithium), and the DRC (cobalt). Although these cases are selected as the most relevant comparators, sharing the similar objective of leveraging upstream market power for industrial upgrading, they differ in terms of four conditions – market power, policy credibility, infrastructure readiness, and capital depth – established based on the experience in Indonesia. In other words, these cases offer excellent variation to examine whether the Jakarta Model is replicable.

Process Tracing and Quantitative Analysis

To identify the causal mechanisms behind Indonesia's geoeconomic agency, this paper combines theory-guided process tracing with three quantitative methods: event study, augmented synthetic control, and trade composition analysis. Process tracing is a within-case method that examines causal links by identifying intervention mechanisms and the sequence of stages through which they operate.²⁶ This method is well-suited to our research question, as this paper aims to examine how and under what conditions Indonesia's export ban led to industrial upgrading. The empirical analysis in Section 3 is organised according to the causal conditions, with each subsection containing both process tracing and quantitative substantiation.

The process tracing reconstructs the causal pathway from the 2009 Mining Law through the 2014 and 2020 export bans to outcomes such as investment relocation, domestic processing capacity, and trade restructuring. By analysing policy documents, industry reports, financial press coverage, investment and trade data, and secondary literature, this paper traces how the interaction of four conditions contributed to Indonesia's success. The quantitative analyses serve as empirical support for the process tracing by showing how each mechanism worked and later serve as the basis for the Downstreaming Readiness Index.

Event Study

Indonesia's nickel export ban announcements in 2014 and 2019 seemingly affected global nickel prices. Previous research has quantified the effects of these announcements, using narrative identification of the policy episodes combined with autoregressive forecasting of pre- and post-event price returns.²⁷ Additional work has gauged the effect of the second ban announcement through a single-asset event study supported by market models.²⁸ To assess the effects of Indonesia's nickel export bans on global nickel prices, this paper employs a single-asset event study methodology for both policy events, following best practices outlined by MacKinlay (1997) and by Brown and Warner (1985).^{29,30} This analysis uses London Metal Exchange (LME) nickel futures prices around two key announcement dates: the first ban on January 10, 2014,³¹ and the reimposition on August 28, 2019,³² where abnormal price movements around these events are identified.

The methodology compares the observed nickel prices after each event with their expected value. Expected returns are estimated using the multi-factor asset pricing model,³³ where nickel daily returns are regressed against returns on the five base metals (copper, aluminium, zinc, lead, and tin) from the LME base-metals complex as well as the ICE US Dollar Index, controlling for commodity and currency movements:

$$R_t^{Ni} = \alpha + \sum_{j=1}^5 \beta_j R_{j,t}^{metal} + \beta_6 R_t^{USD} + \varepsilon_t$$

where R_t^{Ni} denotes expected nickel returns, $R_{j,t}^{metal}$ the returns of control metals, and R_t^{USD} the USD index value. Abnormal returns, which are the deviations of observed prices from expected prices, are then computed during several event windows for each announcement date.

The β parameters are estimated using ordinary least squares (OLS) through an estimation window of [-250, -30] trading days prior to each event, which is long enough to allow for stable estimates without information leakage near the announcement date. Abnormal returns are then accumulated to form cumulative abnormal returns (CARs) using five event windows: [-10, -1] for leakage, [0, 1] and [0, 3] for immediate reaction, [0, 10] for short-term impact, and [0, 30] for persistence. For each window (τ_1, τ_2), CARs are computed as:

$$CAR(\tau_1, \tau_2) = \sum_{t=\tau_1}^{\tau_2} AR_t$$

As it is difficult to ensure robustness when very limited events are available,^{34,35} inference is done using permutation tests. CARs are computed based on 1,000 randomly selected placebo event dates in the sample, with each set of placebo dates omitting a 100-trading-day window around the event date. Non-parametric p -values are generated from the fraction of placebo CARs that exceed the observed CARs, ensuring robust statistical inference despite the small number of events.

Augmented Synthetic Control Method

Export bans are often credited for increasing investor interest and attracting foreign direct investment (FDI) into Indonesia, mostly for nickel processing.³⁶ However, the small number of policy cases makes causal inference difficult, and simple correlations between resource nationalist policies and FDI would fail to account for regional trends and global macroeconomic shocks. Therefore, this study employs a quasi-experimental analysis based on the augmented synthetic control method (ASCM).

The analysis tests the differential impact of the 2020 export ban on downstream FDI in Indonesia relative to a counterfactual “Synthetic Indonesia,” which is built using 21 comparable countries. We restrict comparison cases to EMDEs with credible exposure to industrial policy in critical minerals and the potential to attract downstream-oriented FDI, excluding Global North countries as poor counterfactuals for Indonesia. This donor pool includes major mineral producers across Latin America, Africa, and Asia-Pacific to represent regional and commodity diversity: Argentina, Bolivia, Brazil, Chile, DRC, Ghana, India, Kazakhstan, Madagascar, Malaysia, Mexico, Mongolia, New Caledonia, Peru, Philippines, South Africa, Thailand, Tanzania, Vietnam, Zambia, and Zimbabwe. Only EMDEs are selected to mitigate bias from policy regimes and capital depth in advanced economies. These countries are selected because they appear in the same project level list in Orbis Crossborder Investment (Orbis) and meet our inclusion criteria for downstream-oriented FDI outcomes over the pre-treatment period.

The period analysed includes 2013-2025, where 2013-2019 represents the pre-treatment period, while 2020-2025 denotes the post-treatment period. The 2020 export ban is selected as the treatment event because the pre-treatment period available for the 2014 ban is too short to construct a reliable counterfactual. A conventional difference-in-differences approach cannot be applied in this case due to the lack of parallel trends among different mineral producers. However, ASCM mitigates this assumption through the construction of a weighted donor pool with a bias correction term, which reduces pre-treatment error, ensuring robust inference even when the donor trends are different from those of the treated unit.^{37,38}

The project-level data for downstream-oriented FDI is sourced from Orbis to construct a destination-year panel, which is classified into: (A) core processing (e.g. smelting, refining intermediates), (B) downstream components (e.g. stainless and battery materials such as precursors and cathodes), and (C) battery ecosystem (e.g. battery cells). Our main outcome captures A+B, whereas our secondary outcome, adding ecosystem investment, captures A+B+C. As project FDI is lumpy and sparse in EMDEs, outcomes are aggregated into two-year bins and transformed into $\log(1 + x)$ for the main specifications. Annual data can be subject to excessive volatility due to the announcement of individual projects, potentially causing significant fluctuations in year-on-year FDI inflows, while three-year

aggregates would obscure the exact timing of the onset of treatment in 2020. The two-year window, therefore, smooths idiosyncratic fluctuations and retains the distinction between pre- and post-2020, which is necessary for identifying the treatment effect.

The donor weights (w_j) are determined by minimising the distance between Indonesia's predictor variables and the donors' predictor variables during the pre-treatment period, after which the counterfactual "Synthetic Indonesia" is constructed:

$$\hat{Y}_{1t}^{\text{ASCM}} = \sum_{j=2}^{J+1} \hat{w}_j Y_{jt} + \sum_{j=2}^{J+1} \hat{\gamma}_j Y_{jt}$$

where \hat{w}_j denote donor weights and $\hat{\gamma}_j$ the bias-correction coefficients. The treatment effect is computed as the post-treatment gap between observed and counterfactual outcomes:

$$\hat{a}_t = Y_{1t} - \hat{Y}_{1t}^{\text{ASCM}}$$

As the treatment group comprises only one unit, the statistical inference involves placebo tests where treatment is iteratively reassigned to each donor country, with the p -value being the share of donor gaps that surpass Indonesia's observed gap.

Trade Composition and Import Partner Shift Analysis

To evaluate the extent to which Indonesia's export mix evolved in terms of value chain stages and trading partners, the UN Comtrade data on exports and imports between 2009 and 2024 is used. Previous research suggests that these export bans increased the domestic value-added ratio (DVAR).³⁹ This paper thus analyses the share of upstream, midstream, and downstream products within the export basket of nickel from Indonesia, along with the effect on its major trading partners, such as China and Japan. Table 1 highlights the nickel-related commodities considered in the analysis.

Table 1: Nickel commodities analysed for the trade composition and partner shift analysis

Category	Commodity (UN Comtrade commodity code)
Upstream	Nickel ores and concentrates (260400)
Midstream	Ferronickel (720260)
	Nickel mattes (750110)
	Nickel oxide sinters and other intermediate products of nickel metallurgy (750120)
	Nickel, unwrought (7502)
	Nickel waste and scrap (7503)
	Nickel powders and flakes (7504)
Downstream	Nickel bars, rods, profiles and wire (7505)
	Nickel plates, sheets, strip and foil (7506)
	Nickel tubes, pipes, and fittings (7507)
	Other articles of nickel (wire cloth, grills, finished goods) (7508)

Analysis: How Indonesia Forced Foreign Investment

Indonesia's Nickel Value Chain

The nickel value chain is multi-stage and fragmented, originating from two types of nickel ore: sulphide and laterite. Sulphide ores are the main source of high-purity Class I nickel required for EV batteries, whereas Indonesia's deposits are mostly laterite ores. These laterite ores have mostly been processed via pyrometallurgy, or rotary kiln-electric furnace (RKEF) smelting, to produce Class II nickel, such as ferronickel (FeNi) and nickel pig iron (NPI), which is used for stainless steel production. Laterite ores can also be processed via hydrometallurgy, or the high-pressure acid leaching (HPAL) process, to produce mixed hydroxide precipitate (MHP), which is an intermediate product converted into nickel sulphate for EV battery cathodes.^{40,41}

In Indonesia, the initial objective of the export ban was to promote domestic production of FeNi and NPI for stainless steel.⁴² Although the government also sought to leverage nickel to develop an EV battery value chain, it faced a “hollow middle” (i.e. competitiveness exists in raw materials and final manufacturing but is lacking in intermediates) until around 2021, reflecting its limited capacity to produce nickel sulphate without HPAL facilities.^{43,44} As FeNi and NPI can be refined into high-grade nickel matte as an alternative feedstock for nickel sulphate, Indonesia subsequently encouraged such refining to link stainless steel production to emerging EV battery value chains (Figure 2).⁴⁵

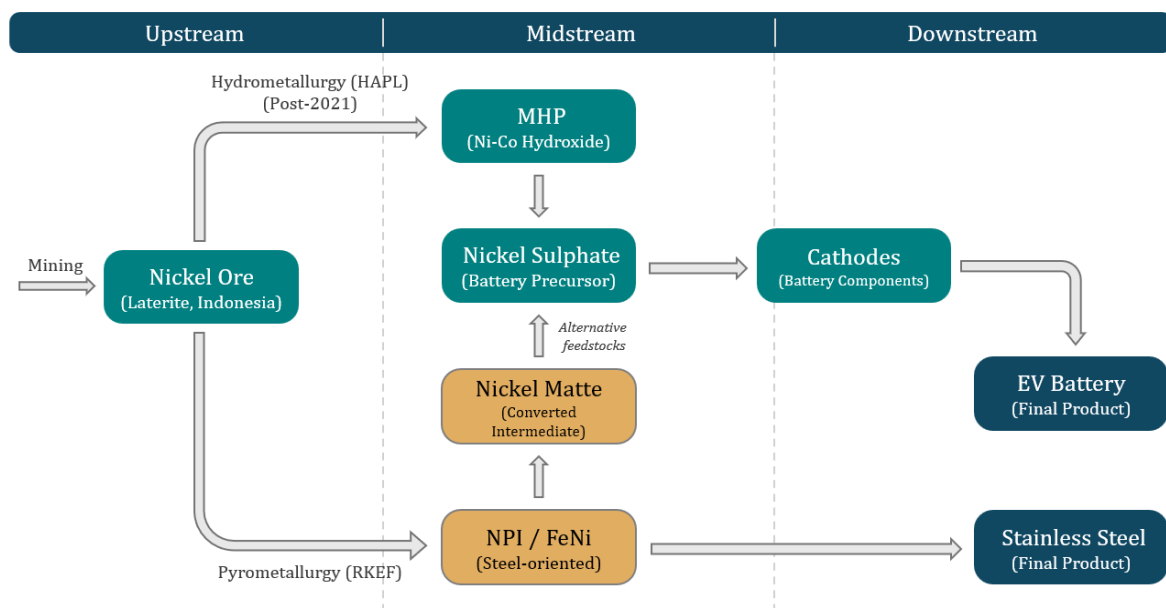


Figure 2. Simple Indonesia's nickel value chain. Source: Authors' illustration based on Khalil and Broughel (2025), and Schröder and Iwasaki (2023)

Market Power and Credible Supply Shocks

The first step in assessing the source of Indonesia's agency lies in its share of global nickel supply. Being home to the largest reserves and accounting for 64% of the world's mined supply by 2024,⁴⁶ Indonesia held a dominant market power – even framed as the “OPEC of nickel”⁴⁷ – such that its importers could not simply circumvent its export decisions by substituting alternative suppliers.⁴⁸ This, in essence, is the enabling condition underpinning the success of the Jakarta model. Facing the threat of credible supply restrictions by such an influential producer, buyers either had to incur far higher

costs by looking for alternative suppliers or relocate their processing facilities to Indonesia. As most of the alternative suppliers lacked comparable laterite reserves, substitution was not a viable option.⁴⁹

This is confirmed by the results of the event study, which show that global markets interpreted Indonesia's policy announcements as a credible supply shock, with global nickel prices increasing following its nickel ore export bans in 2014 and 2019. For the first export ban announcement in January 2014, LME 3-month nickel futures gave a CAR of 4.16% for the immediate window [0,1], 6.00% for the window [0,3], and 8.94% over the short-run window [0,10], all of which are statistically significant (see Table 2). For the announcement in August 2019, abnormal returns were as high as 16.06% in window [0,3] and 10.23% in window [0,10], with even greater significance. For both episodes, there is no significant pre-announcement activity for the leakage window [-10,-1], suggesting that the market reaction is not based on anticipation but is rather a response to the news about the policy change. In addition, the persistence window [0,30] also demonstrates statistically insignificant CAR values, suggesting rapid integration of information into market prices, with broader commodity market movements offsetting the announcement effect over the full month. As all the event windows precede the COVID-19 pandemic, market disruptions due to the pandemic are excluded as a potential confounder. Figure 3 shows LME 3-month nickel futures prices around the export bans, and Figure 4 shows the corresponding CARs.

Table 2: CARs and statistical significance for LME 3-month nickel futures prices

Event Window	2014 Ban		2019 Ban	
	CAR	<i>p</i> -value	CAR	<i>p</i> -value
Leakage [-10,-1]	5.22%	0.204	2.40%	0.588
Immediate [0,1]	4.16%	0.060 (*)	2.31%	0.236
Immediate [0,3]	6.00%	0.040 (**)	16.06%	0.002 (***)
Short Run [0,10]	8.94%	0.058 (*)	10.23%	0.034 (**)
Persistence [0,30]	8.46%	0.232	9.65%	0.192

Note: *** *p*-value < .01, ** *p*-value < .05, * *p*-value < .1

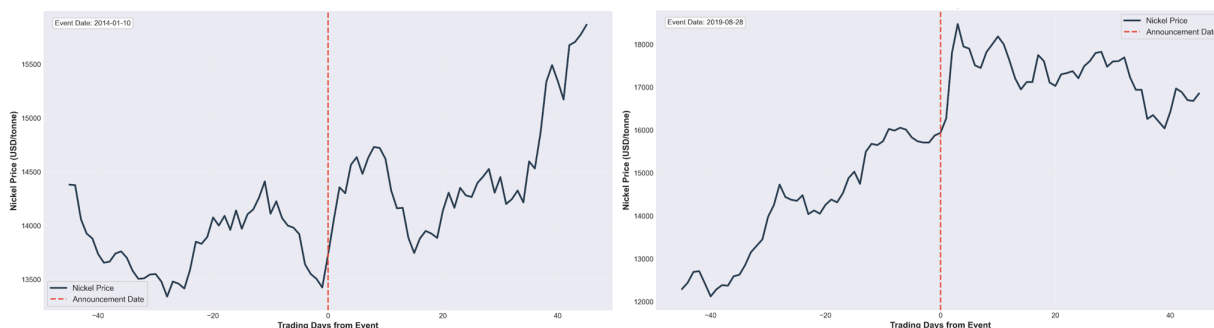


Figure 3: LME 3-month nickel futures prices around the 2014 (left) and 2019 (right) export ban announcements

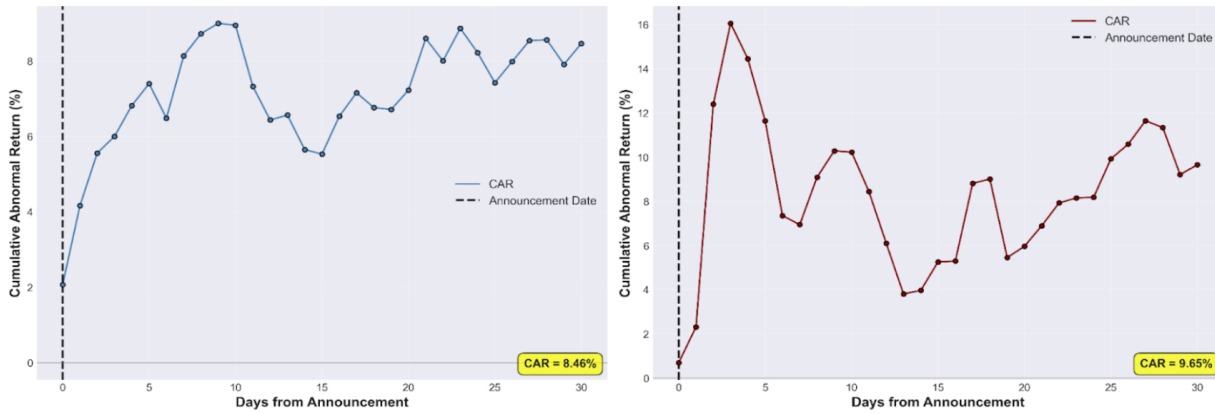


Figure 4. CARs over the full [0,30] window

These price reactions are indicators that market power translated into geoeconomic leverage. Markets repriced their perceptions of supply risk on the back of credible announcements made by Indonesia and the lack of an alternative to the nickel ore in question. That is why the Chinese processing industry had no other choice than to invest in Indonesia’s processing facilities, as the ore was present but not in sufficient quantities or grade.⁵⁰ Hence, investment in Indonesia’s processing capacities is the logical step to address the issue of supply limitations, not despite the export ban, but precisely due to it.

Policy Credibility Through Iteration

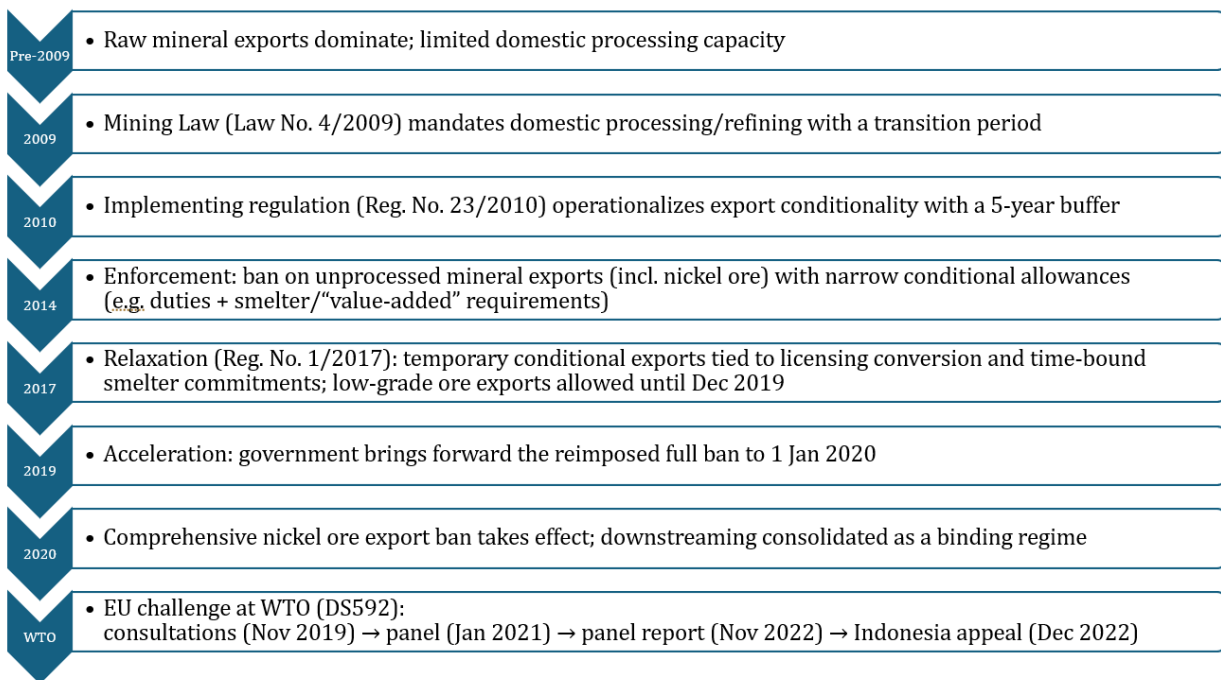


Figure 5: Indonesia’s downstreaming policy timeline (Authors’ illustration based on Guberman et al. (2024), Hopewell (2024), and AfDB (2025))

However, market power itself would not have generated investor confidence if Indonesia’s policies were perceived as being reversible. Investors who were committed to investing billions of dollars in long-lived infrastructure like smelting and refining plants needed assurances that the ban on exports would last for their ten-to-fifteen-year return on investment period. Credibility in this case did not start

ex ante; rather, it built up over time through a series of policy decisions over more than a decade (see Figure 5).

Indonesia's downstreaming agenda was formalised through the 2009 Mineral and Coal Mining Law (Law No. 4/2009), which prohibited the export of raw minerals unless they were processed domestically and mandated all mining firms to develop domestic smelters for purifying extracted ores.⁵¹ Regulation No. 23/2010 made this refining requirement compulsory, with a five-year transition period for firms to procure and install smelting equipment.⁵² When the export ban of nickel ore was enforced in early 2014, however, Indonesia immediately faced a constraint, where domestic nickel processing capacity was still underdeveloped, and both domestic and foreign firms were long concerned about the lack of sufficient infrastructure and large upfront capital requirements.^{53,54} As a result, nickel output in Indonesia fell drastically, export revenues decreased, and pressure came from mining companies that experienced losses.

Indonesia then temporarily relaxed the export ban through Regulation No. 1/2017, which allowed qualifying firms to resume the limited export of nickel concentrates only if firms paid export duties and committed to building smelters by January 2022, when the export ban of nickel ore would be reinstated.^{55,56,57} While this is often perceived as a policy reversal, in fact, this recalibration highlights Indonesia's intent to preserve policy credibility. By making export access conditional on building smelting facilities, the firms got short-term relief in return for investment commitments, while the government remained committed to its long-term policy objective. The downstreaming strategy was also backed by cross-party elite consensus across the Yudhoyono (2004-2014) and Joko Widodo, or "Jokowi," (2014-2024) administrations.⁵⁸ This political continuity, along with Jokowi's Golden Indonesia 2045 Vision to build the EV battery ecosystem, signalled Indonesia's long-term commitment to investors.⁵⁹ The announcement in August 2019 that a complete ban would be brought forward to January 2020, coupled with Law No. 3/2020 that reinforced the government's commitment to investment incentives, marked the completion of this process of ensuring credibility.⁶⁰

The comparison of price reactions between 2014 and 2019 gives an objective measure of credibility that has built up over the years. For the 2014 shock, the abnormal returns accumulated gradually from 4.16% in [0,1] to 8.94% in [0,10], and eventually stabilised at 8.46% in [0,30] (see Figure 3). For the 2019 shock, the abnormal returns increased more quickly, from 2.31% in [0,1] to 16.06% in [0,3], which partly mean-reverted to 10.23% in [0,10] and then 9.65% in [0,30] (see Figure 4). This quicker and sharper reaction in 2019, along with partial mean reversion, aligns with the market environment in which lessons were learned from the 2014 experience, associated with an immediate pricing of Indonesia's commitments. In contrast, the slow buildup in 2014 can be attributed to uncertainty surrounding the ban enforcement.

Infrastructure and Capital Depth via Anchor Investors

Even in the presence of both market power and credible policy, the export ban would not have translated into industrial upgrading, unless firms were capable of constructing processing facilities inside the country. This leads to the third and fourth conditions that distinguish the Indonesian experience from any other: infrastructure readiness and capital depth. The infrastructure was developed

not by the Indonesian State, but rather by Chinese anchor investors within large integrated industrial parks, which were designed to induce FDI and facilitate export-oriented industrialisation.⁶¹

The Indonesia Morowali Industrial Park (IMIP) in Central Sulawesi shows an example of how the process works. After the 2014 export ban, Tsingshan Group, which is the largest stainless-steel producer worldwide, became a leading investor and concentrated its investments in the IMIP via joint ventures, which attracted a cluster of Indonesian and foreign firms with a total investment of USD 8 billion in the park. Although this park was initially barren, the IMIP built all the supporting infrastructure at scale, including 1.9 GW of electricity-generating capacity, a port, and transport infrastructure, reducing logistics costs as the IMIP is located near Indonesia's major nickel mining area. The IMIP also housed multiple smelters and HPAL facilities, which enabled the transition towards value-added processing.⁶²

The Indonesian government provided some investment incentives along with this infrastructure build-out by the private sector. Presidential Regulation No. 55/2019 elevated the development of the EV industry as a national priority, aiming to link upstream nickel to an integrated EV battery value chain.⁶³ Under the Golden Indonesia 2045 Vision, the EV battery ecosystem is vital for Indonesia to become one of the five largest economies by 2045, where it targets to produce an annual battery capacity of 140 GWh by 2030.^{64,65} The 2020 Omnibus Law (Law No.11/202) further reduced bureaucracy and positioned EV battery production as “strategic” to boost investment in nickel processing facilities.^{66,67} Therefore, this policy package consolidated the downstreaming strategy into a more credible one to anchor industrial upgrading, whereby infrastructure investments would be assured a stable regulatory framework.

The IMIP case demonstrates that the export ban ensured a stable supply of unprocessed nickel, while the industrial park lowered the infrastructure and coordination costs for investors. Smelting needs energy, which in turn needs generation capacity, which again needs fuel supply chains. Smelting also needs permits, ports, and transports. All of this would be prohibitively expensive if not for Tsingshan as the anchor investor, having both technical capabilities and resources to undertake all the investments at once. Thus, infrastructure readiness and capital depth signify not preexisting infrastructure built by the state, but rather anchor capital that could build infrastructure as part of its investment.

The augmented synthetic control analysis estimates the causal effect of Indonesia's export ban on investment relocation. By comparing Indonesia's downstream-oriented FDI to a “Synthetic Indonesia” built based on the comparable 21 resource-rich EMDEs that did not implement export bans, the trajectory starts moving upwards after 2020 dramatically (Figure 6). With respect to the narrower definition of downstream investment (core processing and downstream components), the estimated effect over 2020-2022 is 4.56 log points (placebo p -value 0.091), which equates to around 95 times compared to the counterfactual (see Table 3). When we consider a broader definition of downstream investments (EV battery ecosystem), the effect is 3.92 log points over 2020-2022 (p -value 0.046) and continues to be positive until 2024. The placebo analysis further reveals that Indonesia's deviation starts precisely from 2020, when the intervention took place, and that deviations in donor-treated placebos are relatively small and non-systematic (Figure 7). A potential concern is that Indonesia's divergence after 2020 coincides with the COVID-19 pandemic. However, the impact of the pandemic

is absorbed by the synthetic counterfactual as all donor countries faced a similar shock, the placebo test reveals no equivalent divergence among donors between 2020 and 2022, and the divergence persists until 2024 even after the pandemic-induced demand shock had subsided, suggesting that it is the export ban and not common shocks that led to this effect.

Table 3: Estimated average treatment effects (ATT) and statistical significance

Outcome	Period	Case 1 (A+B)		Case 2 (A+B+C)	
		Effect (log \$m)	Placebo <i>p</i> -value	Effect (log \$m)	Placebo <i>p</i> -value
Capex	2020-2022	4.56	0.091 (*)	3.92	0.046 (**)
Capex	2020-2024	3.07	0.136	3.14	0.091 (*)

Note: ** *p*-value < .05, * *p*-value < .1

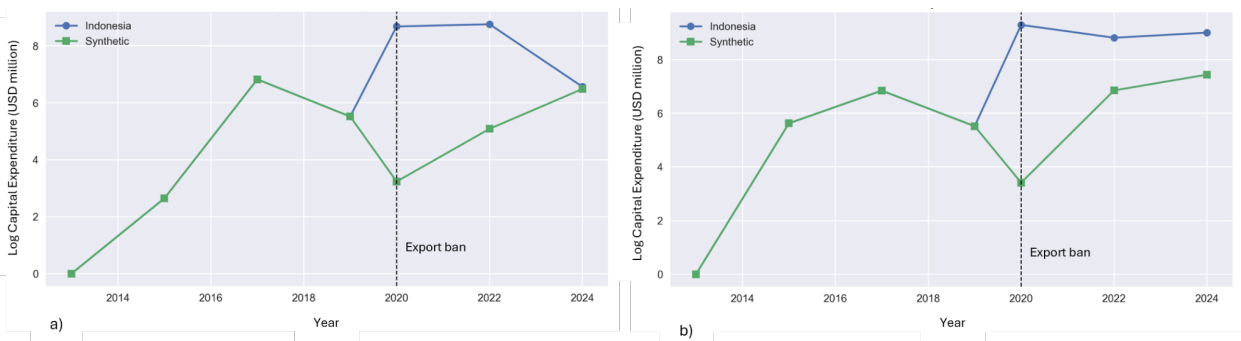


Figure 6: Downstream-oriented FDI in Indonesia and Synthetic Indonesia (ASCM). (a) core processing plus downstream components (A+B); (b) A+B plus the battery ecosystem (A+B+C)

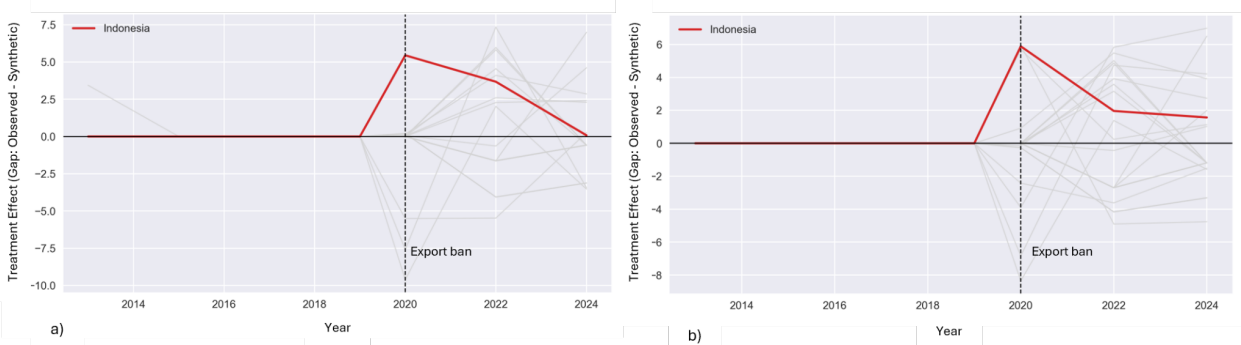


Figure 7: Placebo analysis of treatment effect: Indonesia (red) vs. donor pool (grey). (a) core processing plus downstream components (A+B); (b) A+B plus the battery ecosystem (A+B+C)

The findings from the ASCM demonstrate that the export ban not only disrupted trade flows but also redirected investments. Capital that would have otherwise flowed to processing capacities in China, Japan, or other destinations was instead diverted towards Indonesia, facilitated by industrial parks which were themselves constructed by the diverted capital, thus making the export ban a source of geoeconomic agency.

Trade Reconfiguration as Confirmation

The analysis above demonstrates that market power creates credible price changes, accumulated credibility attracts investments, anchoring infrastructure transforms investments into capabilities, and

deep capitalization generates infrastructure. Our trade composition and partner shift analysis further confirms this, revealing a structural change in Indonesia's trade patterns.

The composition of Indonesia's nickel exports changed significantly following the export bans (Figure 10a). Before 2014, nickel exports were predominantly upstream products comprising nickel ore and concentrates. By 2020, however, upstream products had largely been phased out of the export basket and replaced by midstream and downstream products, such as FeNi, NPI, and matte. This indicates that by limiting raw nickel exports, more value-added stages like smelting are conducted locally. Therefore, there is a shift in the composition of the export basket from raw towards intermediate goods. Although the reconfiguration after 2020 coincides in part with supply chain disruptions caused by the COVID-19 pandemic, the underlying shift started well before, with upstream exports declining steadily between 2014 and 2019, suggesting that the pandemic accelerated rather than triggered this structural shift. Further, the total value of Indonesia's nickel exports rose from below USD 5 billion prior to 2014 to over USD 40 billion in 2024 (Figure 10b), which coincides with the phase-out of upstream products and the scale-up of downstream processing capabilities. Therefore, Indonesia's export bans have facilitated its entry into the higher-value segments closest to its industrial development process, which has been further expanded as capital investment increased.

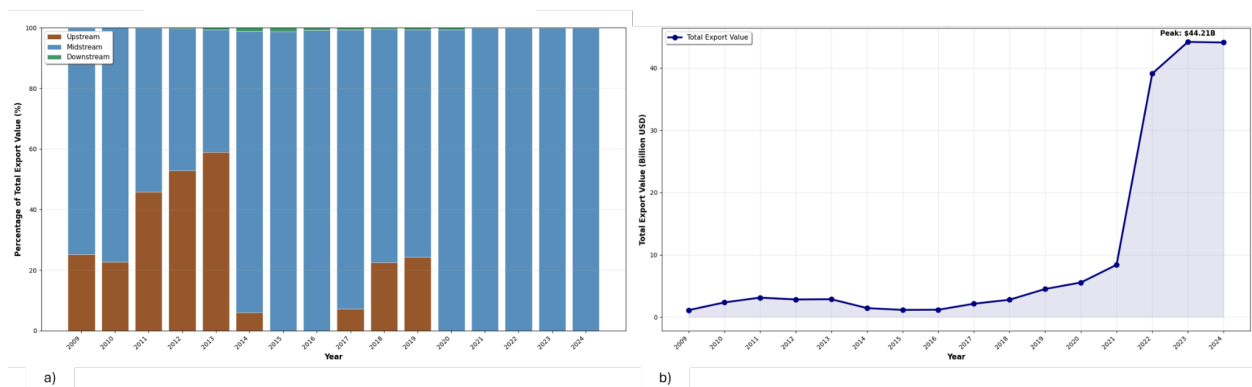


Figure 10: (a) Indonesia nickel export by category (share of total export value): upstream, midstream and downstream; (b) Indonesia's total annual export product values

The partner composition highlights not only the success but also the limitations of this reconfiguration. Indonesia's nickel exports to China increased drastically, which accounts for about 90% of the export value (Figure 11), showcasing the key role of Chinese companies as both investors and offtakers. On the other hand, while traditional partners like Japan discontinued their imports from Indonesia since 2014, choosing to import raw nickel ore from the Philippines and New Caledonia instead (Figure 12), Chinese companies began importing intermediates instead of raw ores. In 2022, the volume of imported matte increased almost sixteen times, reaching the value of USD 2.48 billion against just USD 151 million in 2021 (Figure 13).

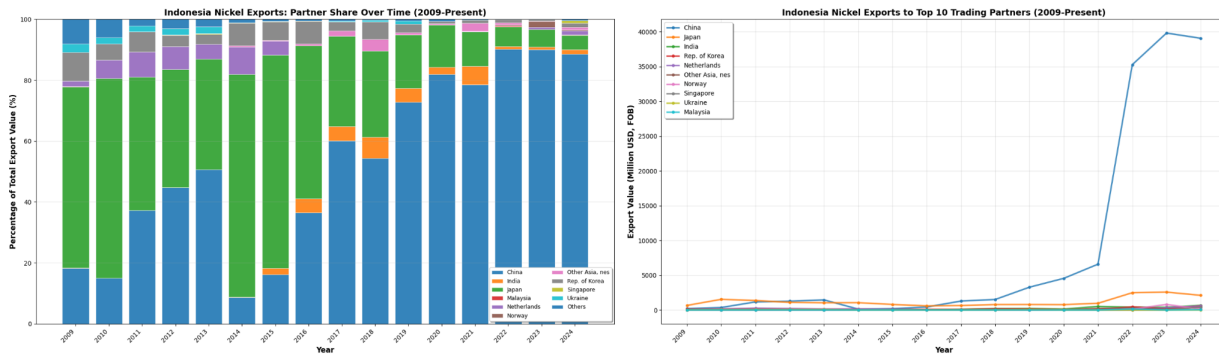


Figure 11: (a) Indonesia’s nickel export partners (share of total export value); (b) total annual export value by partner

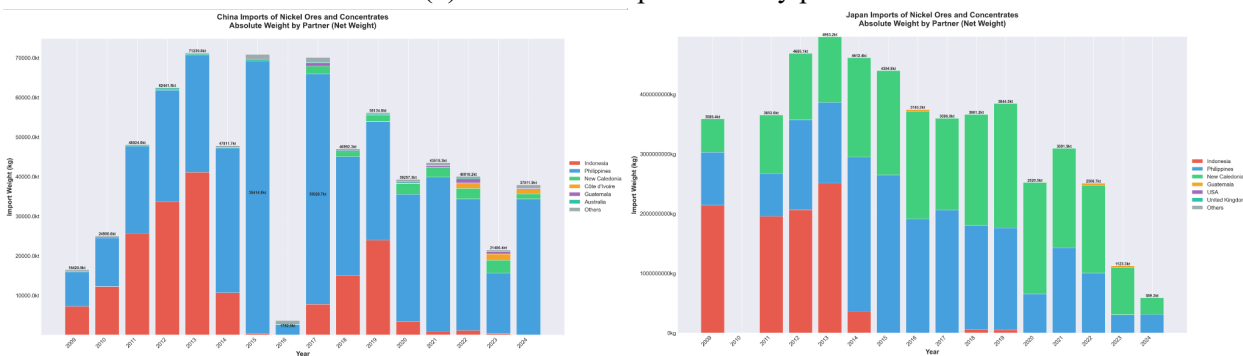


Figure 12: Nickel ore import partners (weight) in (a) China and (b) Japan

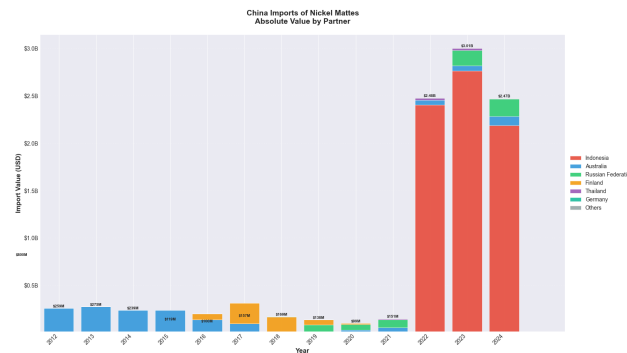


Figure 13: China’s nickel matte import partners (value)

Thus, the trade analysis demonstrates that the conversion stages within the nickel supply chain have been relocated to Indonesia, with corresponding adjustments in trade partnerships. This serves as the confirmation that Indonesia’s geoeconomic agency emerged as a result of the interaction of the four conditions, where market power provided the leverage, credibility sustained it over time, and anchor capital created the infrastructure to turn the policy into structural change within the value chain.

Discussion: Can the Jakarta Model Travel?

The Jakarta model is shaping mineral policymaking in other countries: (i) the Philippines approved (and later reversed) a bill to ban raw nickel exports from 2030,^{68,69} (ii) Zimbabwe banned the export of raw lithium ore in 2022, with its Vice President citing Indonesia’s strategy as “inspiring and educative,”^{70,71} (iii) Namibia has prohibited the export of unprocessed lithium and other critical minerals,^{72,73} and (iv) the DRC, which produced over 70% of the world’s cobalt in 2024, is moving

from export bans to quotas to enhance local refining.⁷⁴ Yet, there is still limited clarity over the extent to which this form of resource nationalism can amount to geoeconomic agency. Therefore, this paper introduces the Downstreaming Readiness Index (DRI) as a cross-country transferability score, measuring whether mineral-rich EMDEs meet the minimum conditions to turn export controls into durable upgrading and bargaining leverage.

Operationalising the Downstreaming Readiness Index

From the process tracing and quantitative analysis, four enabling conditions are identified that enabled Indonesia's geoeconomic agency: market power, policy credibility, infrastructure readiness, and capital depth. Although there exist many adjacent indices, most focus on risk or governance rather than industrial capability, such as Verisk Maplecroft's Resource Nationalism Index.⁷⁵ While some Indonesia-focused studies also construct downstreaming intensity measures within a single country, they do not provide a systematic multi-country framework.⁷⁶ The DRI addresses this gap by aggregating these four enabling dimensions.

Market power assesses the influence a country has on the global market based on its share of the supply of a critical mineral. This index is built upon four components: (i) global production share; (ii) global reserves share (USGS Mineral Commodity Summary 2025);⁷⁷ (iii) market concentration (Herfindahl-Hirschman Index (HHI) for the top three producers); and (iv) substitutability of the mineral. *Market concentration* is calculated as follows:

$$\text{HHI} = \sum_{i=1}^3 (\text{Market share of producer}_i)^2$$

Substitutability indicates the degree to which a mineral can be replaced in its primary end uses, which is scored on a scale of 1 (high substitutability) to 3 (low substitutability), based on IEA demand forecasts and the availability of alternative battery chemistries.⁷⁸ The final index is calculated as:

$$\text{Market power} = \frac{(\text{Production Share} + \text{Reserves Share})}{2} \times \frac{(\text{HHI} + \text{Substitutability})}{2}$$

Policy credibility captures policy attractiveness from industry as well as the regulatory and political environment that conditions mining investment, which is proxied using the Fraser Institute Policy Perception Index (PPI), rescaled to 0-1.⁷⁹ This quantifies enforcement of existing regulations and uncertainty concerning the administration, among others.

Infrastructure readiness captures a country's capacity to host large-scale mining projects, such as smelters and processing plants. The index is built upon the average of four components, each rescaled to 0-1: (i) industrial electricity costs (USD/kWh);⁸⁰ (ii) electricity grid quality (based on World Bank Enterprise Surveys and World Bank World Development Indicators);^{81,82} (iii) transport infrastructure quality (World Bank Logistics Performance Index);⁸³ and (iv) permitting speed (World Bank Doing Business).⁸⁴

Electricity grid quality is calculated as the average of four reliability indicators, including the share of firms experiencing outages, outages per month, sales losses from outages, and electric power transmission and distribution losses.

Capital and offtake depth quantifies the pre-existing investment environment based on four components scored 0-1, calculated as their unweighted average: (i) greenfield projects; (ii) anchor investor presence; (iii) original equipment manufacturer (OEM) offtake depth; and (iv) export credit support.

Greenfield projects measure whether a country can attract and complete large-scale mining projects, scored as $\min(n/5, 1)$, where n is the number of projects with investment over USD 100 million in the past decade that are announced, under construction, or operational.⁸⁵ *Anchor investor presence* reflects whether a country has at least one internationally recognized firm that has knowledge and experience and can lessen the financial risk as well as provide leverage through commercial banks and export credit agencies (ECAs).⁸⁶ *OEM offtake depth* (0-3; normalized to 0-1) indicates the extent of risk mitigation for downstream processing through secured purchase agreements from end-users, with higher scores reflecting direct participation by global automotive OEMs or Tier-1 battery majors rather than spot market sales.^{87,88,89} *Export credit support* (0/1) measures whether downstreaming projects benefit from state-level financial guarantees or ECAs, which are critical for attracting capital to high-risk jurisdictions.^{90,91}

Downstreaming Readiness Index Scores and Discussion

Tables 5-9 present the component scores for each of the four DRI dimensions in each country.

Table 5. Market power: production and reserves shares

Country	Prod. Share (0-1)	Res. Share (0-1)	Mineral	HHI (0-1)	Substit. (1-3)
Indonesia	0.5900	0.4200	Nickel	0.36	2.00
Philippines	0.0900	0.0400	Nickel	0.36	2.00
Zimbabwe	0.0900	0.0200	Lithium	0.21	3.00
Namibia	0.0100	0.0005	Lithium	0.21	3.00
DRC	0.7600	0.5500	Cobalt	0.59	1.00

Table 6: Market power composite

	Indonesia	Philippines	Zimbabwe	Namibia	DRC
Market Power	0.83	0.42	0.42	0.28	0.67

Table 7: Policy credibility score

Component	Indonesia	Philippines	Zimbabwe	Namibia	DRC
PPI	59.75	74.91	18.61	78.96	12.97
Policy credibility	0.60	0.75	0.19	0.79	0.13

Table 8: Infrastructure readiness components

Component	Indonesia	Philippines	Zimbabwe	Namibia	DRC
Industrial electricity cost	0.65	0.10	0.19	0.52	0.43
Grid quality	0.93	0.81	0.58	0.66	0.48
Transport infrastructure	0.57	0.39	0.26	0.30	0.41
Permitting speed	0.54	0.59	0.44	0.59	0.43
Infrastructure readiness	0.67	0.47	0.37	0.52	0.44

Table 9: Capital and offtake depth

Component	Indonesia	Philippines	Zimbabwe	Namibia	DRC
Greenfield projects	1.00	0.00	1.00	0.00	1.00
Anchor investor presence	1.00	1.00	1.00	1.00	1.00
OEM offtake depth	1.00	0.33	0.67	0.33	1.00
Export credit support	1.00	1.00	1.00	1.00	1.00
Capital and offtake depth	1.00	0.58	0.92	0.58	1.00

Table 10 presents the composite DRI scores. Indonesia scores the highest overall (0.78), primarily driven by strong market power (0.83) and capital depth (1.00).

Table 10: Composite DRI

Component	Indonesia	Philippines	Zimbabwe	Namibia	DRC
Market Power	0.83	0.42	0.42	0.28	0.67
Policy credibility	0.60	0.75	0.19	0.79	0.13
Infrastructure readiness	0.67	0.47	0.37	0.52	0.44
Capital and offtake depth	1.00	0.58	0.92	0.58	1.00
DRI	0.78	0.55	0.48	0.54	0.56

The Philippines scores relatively high on policy credibility (0.75) and mid-level on infrastructure (0.47), but lower on market power (0.42) and capital depth (0.58). Relocation incentives are weaker if the hard export bans are implemented, as the Philippines lacks the supply dominance that made it difficult to circumvent Indonesia's export ban. The Philippines can potentially use targeted incentives and negotiated processing commitments to leverage its role as a substitute nickel ore supplier in the region.

For Zimbabwe, while capital depth is high (0.92), it is held back by low policy credibility (0.19) and weaker infrastructure (0.37). This means that investment interest exists, but weak credibility raises the cost of capital-intensive processing in the long term, and inadequate infrastructure can lead to enclave industrialization.⁹² Thus, downstreaming in Zimbabwe could lead to better outcomes with a more stable regulatory environment and better logistics.

For Namibia, policy credibility is the highest among all the comparators (0.79), with mid-level infrastructure (0.52) and capital depth (0.58), but market power is very low (0.28). Without supply dominance, the export ban will not likely force investment relocation. Namibia could benefit from niche midstream activities rather than aggressive export restrictions.

In the case of the DRC, market power (0.67) and capital depth (1.00) are very high, but policy credibility (0.13) is extremely low with moderate infrastructure (0.44). With its market dominance, the DRC may theoretically have considerable bargaining power, yet low credibility makes aggressive restrictions risky, as investors factor in political risk into their calculations of financing costs and contracts.

Overall, the DRI scores showcase that there is no comparator country that replicate all the four conditions that Indonesia possesses. While each country has one or two strengths, each also faces significant constraints in other dimensions. This suggests that the Jakarta model is not a mere formula to be followed, but rather some minimum conditions that countries must satisfy when adopting similar strategies. Thus, simply replicating the same policy instrument would not guarantee the same success. Instead, countries could benefit more by addressing their weakest dimensions or seeking other negotiated approaches such as minerals-for-infrastructure arrangements.⁹³

Finally, despite Indonesia's success with these enabling conditions, there also exist significant limits to the durability of this success. While the park-based model facilitated rapid scaling, it also created "nationalist enclaves," which are geographically concentrated regions that are heavily dependent on Chinese capital.⁹⁴ In other words, gains are distributed unevenly among a small number of firms, leaving surrounding communities underserved.⁹⁵ This leads to the following three constraints. First, Indonesia's downstreaming strategy may represent a *refined dependency*, with majority of its smelters and offtake markets being owned by Chinese firms, which are further adversely affected by the shift towards lithium-iron-phosphate batteries that do not use nickel.^{96,97} Second, Indonesia could face *external legal pressure*, as seen in the 2022 WTO panel ruling against Indonesia.⁹⁸ Scenario modelling indicates that full compliance could erode 60-70% of its export ban's impact.⁹⁹ Third, the expansion of Indonesia's nickel industry is accompanied by *environmental and market-cycle risks*. Hidden costs are projected to exceed USD 2.75 billion, mainly from coal-fired nickel smelting,^{100,101} while structural oversupply has also undermined returns, as demonstrated by BASF and Eramet cancelling a USD 2.6 billion nickel-cobalt refining project.¹⁰² Therefore, durable upgrading cannot be achieved unless these constraints are addressed, and it is evident that the four conditions are necessary but not sufficient to long-term success.

Conclusion

This paper explored when and how Global South countries can exercise geoeconomic agency thanks to their reserves of critical minerals rather than being passive suppliers of unrefined products. Our multi-method empirical design triangulated evidence of strategic agency: (i) an event study in which market priced the 2014 and 2019/2020 ban episodes as credible supply shocks; (ii) an augmented synthetic control analysis in which increased downstream-oriented FDI flowed into Indonesia after 2020 relative to a counterfactual; and (iii) a trade analysis exhibiting a significant shift towards processed intermediates in Indonesia's export basket, where major downstream countries re-sourced raw materials elsewhere and imported more nickel intermediates from Indonesia. This demonstrates how Indonesia successfully exercised geoeconomic agency and re-sited significant conversion stages of the nickel value chain into the country.

Furthermore, we have introduced the Downstreaming Readiness Index (DRI), which reframes policy diffusion as a question of feasibility, where downstreaming is a capacity-dependent strategy with four enabling conditions: market power, policy credibility, infrastructure readiness, and capital depth. This paper applied the DRI to four Global South countries, which face different constraints for adopting export controls. While some exhibit credibility without leverage, others possess leverage without credibility, or others have capital interest but lack the infrastructure required for reliable processing. This heterogeneity implies that the outcomes of downstreaming are likely to differ systematically, and export controls could create other risks such as refined dependency and enclave industrialization.

This paper also highlighted constraints in discussing agency. Downstreaming can produce new bargaining asymmetries and lock resource-rich countries in concentrated dependence. Besides, global oversupply paired with weak demand can depress prices and undermine investment projects. Hence, a Geoeconomic Global South is an unevenly distributed strategic capacity that depends not only on resources, but also on institutions, infrastructure, and the ability to manage the costs and legitimacy of industrial upgrading. Indonesia demonstrates that geoeconomic agency is possible in critical minerals, but can only travel under a narrow set of conditions and remains inseparable from the political, distributional, and environmental conditions on which upgrading is pursued.

Appendix A: Downstreaming Readiness Index - Detailed Methodology

This appendix sets out the full methodological details of the Downstreaming Readiness Index (DRI), including data sources, scoring rubrics, normalization steps, and country-level evidence for each component. The DRI is calculated as the simple average of four sub-indices, each rescaled to 0-1: market power, policy credibility, infrastructure readiness, and capital depth. Higher values indicate greater readiness.

A.1. Market Power

Market power integrates four components: global production share, global reserves share, market concentration, and substitutability.

A.1.1. Production and Reserves Shares

Production and reserves shares for each country's relevant mineral are sourced from the US Geological Survey Mineral Commodity Summaries 2025.¹⁰³ Although Namibia's economically defined reserves are small, measured resource base is larger.

A.1.2. Market Concentration (HHI)

Market concentration is derived from the HHI for the top three global producers of each mineral.

A.1.3. Substitutability

Substitutability is scored 1 (high substitutability) to 3 (low substitutability). Nickel is scored 2/3 (moderate) as its role in EV batteries is increasingly substituted by LFP batteries, while the IEA still projects its demand would double by 2040. Cobalt is scored 1/3 (high) as it is highly substitutable and its demand is projected to soften by 2040. Lithium is scored 3/3 (low) as it is one of the main inputs for lithium-ion batteries, where the IEA forecast its demand would grow sharply through 2040.¹⁰⁴

A.2. Policy Credibility

Policy credibility is proxied by the Fraser Institute Policy Perception Index (PPI). The PPI aggregates survey responses on uncertainty regarding the administration, interpretation, and enforcement of regulations; environmental regulations; regulatory duplication; taxation; disputed land claims; infrastructure; socioeconomic agreements; and political stability. The PPI in 2024 is based on responses from mining companies that reported USD 6 billion in exploration spending, which provides a strong signal at an industry level.¹⁰⁵

A.3. Infrastructure Readiness

Infrastructure readiness is calculated as the average of four components: industrial electricity costs, grid quality, transport infrastructure, and permitting speed. Each component is rescaled to 0-1, where higher values reflect stronger capacity to host large-scale mining projects, such as smelters and processing plants.

A.3.1. Industrial Electricity Costs

Mineral processing facilities, such as nickel smelters, are energy intensive.¹⁰⁶ For reference, one ton of FeNi requires approximately 5,500-8,000 kWh of electricity to be produced.¹⁰⁷ Therefore, industrial electricity costs are a significant determinant of operational viability. For Indonesia and the Philippines, costs are sourced from GlobalPetrolPrices.com business electricity prices.^{108,109} For Zimbabwe, Namibia, and the DRC, costs are sourced from the Mining Industry Survey Report by the Zimbabwe Mining Suppliers Association (ZIMSA).¹¹⁰ Piecewise normalization is used with a floor of 0.03 USD/kWh, a ceiling of 0.18 USD/kWh, and a pivot of 0.08 USD/kWh.

Table A.3.1: Industrial electricity costs

Country	Cost (USD/kWh)	Score	Source
Indonesia	0.065	0.65	GlobalPetrolPrices.com (business)
Philippines	0.160	0.10	GlobalPetrolPrices.com (business)
Zimbabwe	0.142	0.19	ZIMSA (2024)
Namibia	0.078	0.52	ZIMSA (2024)
DRC	0.095	0.43	ZIMSA (2024)

A.3.2. Grid Quality

Even when electricity prices are competitive, grid reliability is important to ensure continuous operation of a heavy industrial load consumer. To quantify grid quality, four reliability indicators are used: (i) share of firms experiencing electrical outages; (ii) average outages per month; (iii) sales losses due to electrical outages (all from World Bank Enterprise Surveys);¹¹¹ and (iv) electric power transmission and distribution losses (World Bank World Development Indicators).¹¹² Each indicator is normalized using piecewise normalization based on the global minimum, maximum, and average, which is then averaged to calculate the grid quality score.

Table A.3.2: Grid quality

Indicator	Indonesia	Philippines	Zimbabwe	Namibia	DRC	Min	Max	Avg
Firms experiencing outages (% of firms)	12.7 (2023)	43.9 (2023)	76.5 (2016)	53.7 (2024)	77.0 (2024)	0.1	100	44.8
Average outages per month	0.2 (2023)	0.8 (2023)	4.5 (2016)	1.2 (2024)	11.0 (2024)	0	41.9	3.3
Sales losses from outages (% median)	0 (2023)	0 (2023)	0 (2016)	0 (2024)	2.0 (2024)	0	15	0.6
Transmission & distribution losses (% of output)	6.45 (2023)	9.59 (2023)	22.48 (2016)	39.22 (2022)	9.04 (2022)	0.28	84.8	29.5
Grid quality score	0.93	0.81	0.58	0.66	0.48			

A.3.3. Transport Infrastructure

Transport infrastructure quality is based on the World Bank Logistics Performance Index (LPI) infrastructure score, which assesses the quality of trade- and transport-related infrastructure including ports, railroads, roads, and information technology systems.¹¹³ The LPI infrastructure score 1-5 is rescaled to 0-1 through piecewise normalization.

Table A.3.3: Transport infrastructure

Indicator	Indonesia	Philippines	Zimbabwe	Namibia	DRC
LPI Infrastructure Score	2.83	2.26	1.87	2.00	2.30
Transport Infrastructure	0.57	0.39	0.26	0.30	0.41

A.3.4. Permitting Speed

State capacity to authorize large construction projects within predictable timelines is vital for enabling downstreaming. Thus, permitting speed is proxied using the “Dealing with Construction Permits” score by World Bank Doing Business (2020).¹¹⁴ While this was later discontinued due to concerns over data irregularities, the archived series still provides a transparent snapshot for our analysis. The score 0-100 is rescaled to 0-1.

Table A.3.4: Permitting speed

Indicator	Indonesia	Philippines	Zimbabwe	Namibia	DRC
Dealing with construction permits score	66.8	70.0	60.0	70.0	59.5
Permitting speed	0.54	0.59	0.44	0.59	0.43

A.4. Capital and Offtake Depth

Capital and offtake depth is based on four 0-1 components: greenfield projects, anchor investor presence, OEM offtake depth, and export credit support.

A.4.1. Greenfield Projects

Although Indonesia only operated two nickel smelters before 2014, this number increased to forty-three by 2023.¹¹⁵ Similarly, there are at least five qualifying projects in Zimbabwe and the DRC each, but no projects are identified that meet the threshold in the Philippines and Namibia.^{116,117}

A.4.2. Anchor Investor Presence

Indonesia's anchor investors are mainly from China, such as Tsingshan Holding Group, the world's leading stainless steel producer.¹¹⁸ In the Philippines, Japanese investors such as Sumitomo Metal Mining are more present.¹¹⁹ Zimbabwe hosts projects that are funded by the Chinese giant, Zhejiang Huayou Cobalt.¹²⁰ On the other hand, Namibia and the DRC host major anchor investors based outside of Asia, like SQM from Chile in Namibia and Glencore from Switzerland in the DRC.^{121,122}

A.4.3. OEM Offtake Depth

Countries are scored 0-3 based on offtake integration, which is then normalized to 0-1.

Table A.4.3: OEM offtake depth

Country	Raw Score (0-3)	Normalized (0-1)	Justification
Indonesia	3	1.00	Ford-Vale-Huayou EV battery deal ¹²³
Philippines	1	0.33	Sumitomo refinery linkage ¹²⁴
Zimbabwe	2	0.67	Huayou battery-major integration ¹²⁵
Namibia	1	0.33	JOGMEC upstream cooperation ¹²⁶
DRC	3	1.00	Direct Tesla cobalt commitment ¹²⁷

A.4.4. Export Credit and State Backing

This indicator incorporates whether projects benefit from state-level financial guarantees or ECA support, which is a significant factor in attracting capital to high-risk jurisdictions. All five countries have in some way secured export credit or state-backed financing, which reflects the strategic importance of these countries' mineral resources.^{128,129,130,131,132}

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