Domestic value-addition & critical mineral value chains

How effective are industrial, investment & trade policies?

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Introduction by the editors

The study has been commissioned by the Sector Project Trade and Investment for Sustainable Development of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The Sector Project operates as a partner for the German Federal Ministry for Economic Cooperation and Development (BMZ) since 2002 and mainly operates in two closely connected fields of activity: advising BMZ on development-oriented trade policy and approaches as well as on instruments for implementing trade-related development cooperation.

Trade as a key driver to sustainable economic growth and prosperity is a cross-cutting issue that is structurally embedded in the policymaking and portfolio design of German development cooperation, and development issues are integrated into trade policy. The main goal of Germany's activities is to support developing countries to achieve the anticipated positive results for employment and poverty reduction related to participation in world trade. Crucial factors here include the way in which international rules relating to trade are structured, uniform policies in developing countries and industrialised countries (policy coherence) as well as structural requirements in developing countries.

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LIST OF ACRONYMS USED

BHRRC	Business & Human Rights Resource Centre
BRI	Belt & Road Initiative
CRM	Critical Raw Materials
DRC	Democratic Republic of Congo
EU	European Union
EV	Electric Vehicles
FDI	Foreign Direct Investment
GVC	Global Value chain
IEA	International Energy Agency
KPI	Key Performance Indicators
LME	London Metals Exchange
LMIC	Low and Middle-Income Countries
MoU	Memorandum of Understanding
MSP	Minerals Security Partnership
OECD	Organisation for Economic Co-operation and Development
PGM	Platinum Group of Metals
R&D	Research and Development
RE	Renewable Energy
REE	Rare Earth Elements
SEZ	Special Economic Zone
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
WITS	World Integrated Trade Solutions
WTO	World Trade Organisation

Executive summary

A diverse array of clean energy technologies, integral to both industrial progress and sustainable development, are highly dependent on specific minerals for their production. Reflecting this reliance, the deployment of solar photovoltaic and wind energy increased by 75% in 2023, while sales of electric vehicles rose by 35% compared to the previous year (IEA, 2024). These significant expansions, coupled with demand from other sectors such as defence, have contributed to a global surge in the consumption of critical minerals.

Many of these minerals are categorised as Critical Raw Materials (CRMs) due to their essential role in industrial activity and the potential risks associated with supply disruptions, which arise from concentrated supply chains and import dependencies.

Concerns regarding China's dominance in upstream CRM segments, alongside increasing restrictions on mineral ore exports by CRM ore rich low and middle-income countries (LMICs), have prompted major economies, such as the European Union (EU) and the United States (USA), to implement demand-driven CRM policies. These policies emphasise diplomatic engagement with LMICs, with a focus on commitments to value-added activities and strategic investments.

In response, numerous LMICs have formulated policies that condition access to their CRM ore resources on investments in value-added activities and integration into Global Value Chains (GVCs). The aspiration to leverage mineral wealth for economic development has long been a central objective of government policy. However, the current impetus for LMIC governments to pursue value-added investments is shaped by four key factors:

1) recent price increases for CRM ores,
2) the emergence of high-income countries as primary export destinations,
3) the distinct characteristics of CRMs as traded commodities, and
4) resource nationalism as a strong political motivator.

These supply-side CRM policies aim to facilitate value-added investment within a GVC framework adopt the following approaches:

1) market joining: initial entry into a GVC at a single-product node.
2) market fixing: expansion of existing GVC operations through increased production volumes or a greater number of participating firms.
3) market specialization: deepening of GVC operations through expansion into additional upstream and downstream nodes, thereby enhancing linkages with the domestic economy and fostering sector-wide development beyond a singular product focus.

To achieve these objectives, LMICs use a combination of industrial, investment and trade policy to primarily shape an investing firm's cost competitiveness. Governments employ cost subsidies in market joining and market fixing, while strategic interests largely drive market specialization. Trade policies are frequently used as instruments in supply-driven CRM policies to mandate domestic value addition. For example, Mongolia employs export taxes, while Zimbabwe and Ghana have implemented export prohibitions to incentivise domestic processing activities.

As both demand and supply-side CRM policies remain in the early stages of implementation, assessing their effectiveness using national industrial or trade data was not possible. Since companies ultimately undertake value-added investments, their willingness to invest was used as a primary measure of policy effectiveness. The review of case studies noted that while the presence of CRM geological assets is a prerequisite for attracting such investments, it is not a sufficient condition on its own. It further demonstrated mixed success in linking access to CRM ore deposits with value-added investments. Firms rarely consider investment and trade policy incentives/restrictions adequate to counterbalance domestic constraints unless strategic considerations outweigh purely economic factors.

This mixed success can be attributed to two primary reasons. First, effective policy targeting by LMIC governments for value-added investments requires an understanding of the specific value drivers associated with a given product. When a mineral's value is predominantly derived from its raw content, policies aimed at securing resource access are most effective. However, when value creation is contingent upon non-mineral factors—such as advanced processing technologies, a skilled workforce, or efficient logistics—policies that enhance cost competitiveness and strengthen the broader industrial framework yield superior

outcomes. A frequent misalignment in LMIC policy design is the use of trade restrictions targeting raw materials in contexts where technological and industrial capabilities are the primary determinants of value.

Second, while numerous supply-side CRM policies have been announced, the requisite institutional frameworks, governance structures, and regulatory mechanisms necessary for their effective implementation are often lacking. Many of these policies suffer from shortcomings, including an excessive reliance on trade policy instruments and a failure to address critical factors such as environmental and social impacts, as well as opportunity costs associated with CRM value addition. A more comprehensive approach to policy design is required; one that recognises the interconnectedness of various policy instruments and their broader implications.

The effectiveness of CRM policies can be evaluated through the lens of direct support: policies that directly assist firms in achieving their investment objectives are more likely to succeed. Conversely, policy strategies that rely excessively on trade restrictions while neglecting domestic firm development and industrial infrastructure are likely to deter investment.

International partnerships can play a crucial role in assisting LMICs in overcoming challenges related to CRM policy implementation. This report underscores the necessity of a more holistic and strategically nuanced approach to CRM policy formulation and implementation. Ensuring informed decision-making through robust knowledge-sharing mechanisms, well-structured policy design, and a comprehensive evaluation of the advantages and disadvantages of various policy instruments is essential for achieving sustainable and effective outcomes.

1. Introduction

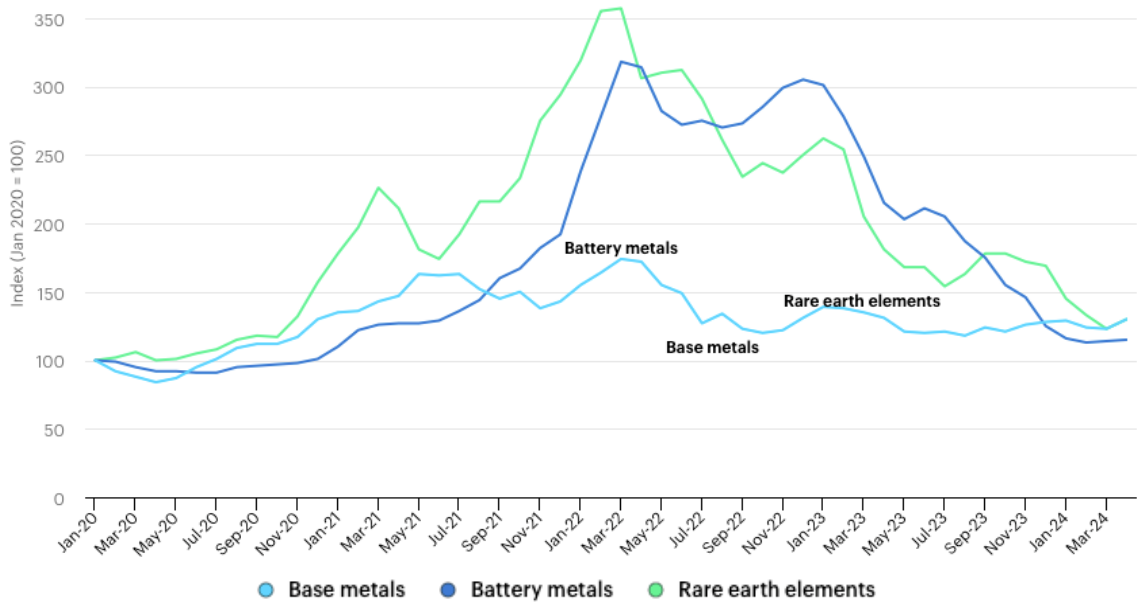
The use of natural resource wealth as an avenue for economic development and growth is not a new concept. The link between natural resources and economic development has been extensively studied, both its positive and negative aspects (IIED, 2009). Governments, such as those in Australia and Canada, have successfully used their mining sectors as a central pillar of economic growth, eventually diversifying their economies. Chile and Peru are currently following similar growth diversification strategies by building on the success of their mining sectors.

Others have achieved more limited results. For example, while mining plays a central role in the South African economy, the government has achieved moderate success in creating industrial activity and diversifying the economy. For others, the mining sector has failed to deliver a wider impetus for economic growth. The sector functions more as an enclave, generating a steady flow of fiscal revenues for the government, while offering minimal employment opportunities and contributions to the rest of the economy (Pegg, 2006). For example, successive governments in Namibia, Sierra Leone, and Papua New Guinea have struggled to embed the mining sector within a wider economic and industrial complex, with limited value-added investment projects to show for their efforts.

The experience of resource-rich LMICs during the 2003-2008 commodity price boom held the promise of generating economic growth from their mineral sectors.[1] The increase in demand for minerals, resulting in an increase in exports and prices, was seen as an opportunity to increase Foreign Direct Investments (FDI) in the mining sector. The FDI would in turn lead to more investments in the wider economy. This growth failed to materialise for many (UNDP, 2016). During this period, in general, government policy focused on attracting investors to the mining sector, with some emphasis on local content policy. This mandated purchase of goods and services from the domestic economy had the objective of spreading the benefits from mining FDI to the wider economy. Creating value-added products from the mined ore was not a major feature of these policies.

In 2019, the price for a select sub-group of mineral commodities (battery metals and rare earth elements (REE)) began to increase (Figure 1).

Figure 1 Price developments of minerals & metals by category (2020 - 2024)



Source: IEA (2024) <accessed 27.12.2024>

[1] The 2003-2008 commodity price boom saw an extended increase in the price of raw materials, with some prices more than doubling over the period. Other mineral commodity prices booms were experienced in 1950-51 (linked to industrial raw material supply security concerns from the Korean conflict) and 1971-75 (linked to the OPEC price increase).

Contrary to the previous commodity price boom where almost all minerals saw a price increase, the price increase was seen mostly for a sub-group includes lithium, cobalt, graphite, manganese and others. These are referred to as battery minerals or critical minerals[2]. Once again, the potential for delivering economic growth from the mineral sector appeared.

The response by some LMIC governments was to make a resolute effort to capitalise on this opportunity, by directly linking their CRM mining sector with industrial activity. This focus on industrial activity and value-addition is different from the previous commodity price boom era, both in the number of countries attempting such policies and the vigour with which they are being attempted (See IEA Critical Minerals Policy Tracker for the number of countries with policies).

Given this background, this report seeks to answer three questions:

1. Why is the recent period of CRM ore price increase driving governments to seek more value-added investment activity than in previous mineral price booms?
2. How is this value-added objective being addressed through policy?
3. How effective are the policy approaches in delivering value-added investments?

The first question is addressed in this chapter, looking at the convergence of GVC frameworks, the focus on creating backward and forward linkages and the characteristics of CRM commodity markets.

Chapters 2 and 3 take the theoretical framework presented in Chapter 1 and using country case studies address the question of how value-added objectives are being targeted through government policies.

Based on the patterns observed in the previous chapters, Chapter 4 turns to the question of effectiveness of these policies and the ideal policy mix.

Chapter 5 returns to the theoretical structure and the findings and provides an analysis for creating an effective policy mix for CRM value-added investments.

Chapter 6 offers recommendations for international development partners to support LMICs in their value-added policy objectives.

1.1. Research approach & scope

The research findings presented in this report have followed an inductive approach. This entailed the gathering of information and insights, which were then analysed to note the emergence of patterns. The patterns were interpreted using industrial, trade and investment theory, within a GVC framework. The limitations of data availability did not allow for a quantitative analysis to be carried out. Therefore, the results are presented as a narrative. Where possible, case studies have been provided to validate the contentions made in the report.

Information was collected through the review of existing literature from academic journals, industry reports, government documents and research from international development banks. The review was supplemented by unattributable discussions with stakeholders from government agencies, mining industry, investors and experts in critical mineral industries (such as Electric Vehicle (EV) and Renewable Energy (RE) manufacturers. Stakeholders from civil society organisations and consultancy firms advising governments, both in the Global North and South, have also been consulted.

The scope of the literature reviewed, and consultations were as follows:

- Government policies and strategies which had a declared objective to promote value-added activity from CRMs, where restrictive trade policy was employed. Therefore, countries that have used strategies that reflect open-market principles were not included in this study.
- The focus has been on LMICs. Countries such as Canada and Australia, which have CRM ore assets, have not been included. An analysis of China's strategic approach to CRM value chain development was agreed to be out of scope for this report.
- The intention of the researchers was to focus on CRM value-added activity that takes place beyond smelting and refining. The aim was to consider policies that advance investments in intermediate products and final products. Given the dearth of such projects in LMICs, this consideration was relaxed, and refining projects were included to allow for more case studies and policy analysis.

[2] The discussion on the definition of critical minerals is provided in Chapter 2.

- The initial scope of the case studies was to be limited to CRMs (as listed under the EU Critical Minerals List). Again, the lack of such cases in LMICs led to this limitation being relaxed and examples from minerals deemed as strategic (copper, graphite, nickel) as well as chromium ore were included.

1.2. Value-addition pathways

There are many pathways from mineral extraction to industrialisation and diversification of the economy to achieve sustainable growth. These pathways are based on different political economy considerations, type of minerals being extracted, government approach to industrial and trade policy and global market conditions. Due to limited space, this report will not go into the details of the various historical pathways taken by governments.[3]

The report focuses on one growth pathway that links the mining sector to value-added/industrial activity, that is relevant in understanding the policy approach of CRM ore rich countries under review here. This pathway has three component concepts: The first is the framework of GVCs. In the following discussion the concept is explored from a manufacturing/industrial view and does not take into consideration the nuances of agricultural or forestry-based value chains, which differ in some respects. The second is the concept of linkages, which helps embed GVC participation into the domestic economy. The third is the understanding of minerals as traded commodities, which creates specific characteristics for CRM ores.

The discussion in this chapter remains on establishing a theoretical understanding. How these concepts have been operationalised is covered in the next chapters.

Global value chains

A manufactured product, from its inputs to assembly, goes through several stages of value-addition. In the early industrialisation period, these processes were largely carried out by one company within one industrial unit. For example, automobile manufacturing companies would produce most engine components as well as the car bodies and interiors, while sourcing the metallic and non-metallic raw materials (including plastics and rubber) from elsewhere. With the advent of industrial clusters (different input providers working within the same geographical area), advances in communication (IT), 'just-in-time' production processes and more effective transportation and labour specialisation, manufacturing began to be divided up by 'value-added stages' amongst different companies. Hence, the parentage of the final product could be traced back to several companies – or tiers of suppliers.

The central tenant of the value chain was this: division of the stages of production is valid where each stage generates economic value for a company, i.e., it generates higher revenue than the cost of its inputs and processing. When such a production chain stretches across different countries it is referred to as a GVC. It should be noted that not all production stages add value to a product. Simply breaking up the manufacturing process across different companies does not create a value chain[4].

GVCs have proliferated across manufactured products, from low-technology products such as clothing and shoes, to high-technology products such as aeroplanes. Tier suppliers and assemblers have moved operations to countries that offer the best operational advantage. These advantages can be based on labour and utility costs, as well as market access created through trade preferences. For example, many African and Asia-Pacific countries saw an increase in investment in their clothing sector to benefit from tariff free access to the USA and the EU under the African Growth and Opportunity Act (AGOA) as well as the Generalised Scheme of Preferences (GSP) schemes respectively.

[3] For a discussion of these pathways, please see Auty (2003).

[4] For example, in the manufacturing of electric battery anodes, graphite flake concentrates are reduced to micron size. This material is then mechanically shaped into a spherical form and undergoes further purification. The spheres are then coated with a hard carbon shell. In terms of manufacturing activity three steps have been taken: 1) flake concentration, 2) shaping, and 3) coating. The market will consider graphite flakes and fully coated graphite spheres to have 'value' and will be willing to pay a price for these products. The market will not pay for 'shaped but uncoated' graphite flakes as these are not considered to have 'value'. In fact, if the market was to offer a price, it would be lower than that for graphite flakes. Therefore, while 'manufacturing' activity has taken place, value creation has not for shaped but uncoated graphite flakes.

Therefore, participation in GVCs has become a common tool for many LMICs to establish domestic industrial activity. The same principles are now being applied to the mining sector and associated GVCs.

Forward & backward linkages

A corollary emerging from GVCs was the establishment of forward and backward linkages. Governments seeking to embed GVC participation within their wider domestic economy began to direct policy at encouraging linkages with other domestic actors. For backward linkages (provision of goods and services that are inputs) local content requirements became a common policy tool. It advocated or mandated firms to purchase a percentage of their inputs from the local economy. For example, in the mining sector the purchase of food, petroleum, basic machinery, security, accounting and equipment servicing from the domestic economy emerged.

Forward linkages (provision of the output to other domestic firms) focused on minimum levels of output to be designated or made available to the domestic market before exports were allowed. Ores and concentrates were required (encouraged) to undergo the first stage of processing (smelting and refining) in-country. In some cases, a further requirement for a minimum level of processed minerals to be made available for domestic intermediate product manufacturers was applied.

Both forward and backward linkages use the premise of capitalising on one manufacturing activity (participation in the GVC) to create further industrial activity by providing a source of demand for goods and services, a demand that was not previously present in the domestic economy.

While the success of forward and backward linkages differs by sector, the creation of linkages as a policy for industrial development has become more common for LMICs. There is a split between government approaches – some governments have focused on creating forward linkages only, whilst others considered both forward and backward linkages.[5]

Minerals as traded commodities

Minerals, from base-metals (aluminium, copper, lead, nickel, tin, zinc) to precious metals (gold, silver, Platinum Group of Metals (PGMs)), have been widely traded as commodities over their history. Presently, they have three distinguishing characteristics:

1. Minerals (in metal form) are traded as standardised products with very little differentiation.[6] For example, a Grade A copper cathode will have 99.98 to 99.99% copper content on delivery, regardless of where it is mined, processed and refined.
2. International prices are determined through a transparent open market process (electronic or through trading) at established exchanges, such as the London Metal Exchange (LME), Shanghai Metals Market and New York Mercantile Exchange.
3. Given the standardised product and open-trading of minerals, mining companies operate as price-takers, i.e., the price for their output is established elsewhere. Some margins may exist for mining companies for specialised materials (for example for low emissions produced copper/steel), but this price reflects the underlying international price.

Given these characteristics, minerals as traded commodities mainly function under near-perfect market conditions. Supply and demand are determined internationally (by economic growth rates and their value as financial assets). Prices are set internationally through trading on large international exchanges. Given the diverse geographical location of mining assets, no country has a supply monopoly.[7] Therefore, resource-rich country governments have been limited in the extent to which they can pro-actively influence supply and price of these minerals. This limits the scope of government policies to enact domestic development and growth. The policy space has largely been corralled between attracting foreign investors to the mining sector and using some level of local content policy to encourage linkages to benefit the wider economy.

The emergence of CRMs as a group

The UN Paris Agreement (UNFCCC, 2015) focused the attention of global governments on climate change mitigation and adaptation, with the objective of staying within the 1.5°C limit of global temperature rise.

[5] For more information on the effectiveness and successes of linkages, see Ojaleye (2021).

[6] Some differentiation based on 'green' credentials is emerging, such as 'green steel'. However, the 'green steel' product will also be standardised on point of delivery across all producers.

[7] There were some exceptions, such as the extraction of PGMs where South Africa holds near monopoly over supply.

Reducing global emissions and shifting towards resource efficient technologies are central tenets to achieve the Paris Agreement targets.

Efforts to reduce greenhouse gas emissions is following two major tracts within the energy and transport sectors. The former has focused on an increase in renewable energy (RE)/electricity production moving away from coal and oil-fired electricity generation, while the latter is seeing a shift to electric vehicles (EVs) away from internal combustion engines.[8]

The increase in production of RE and EVs, in line with meeting the Paris Agreement targets, has increased the demand for minerals. These include base-metals (such as copper and nickel) as well as demand for CRM ores (such as cobalt, lithium, graphite, manganese and REEs) that were not traditionally traded internationally as mineral commodities.

These CRM ores have distinguishing characteristics when compared to the major traded mineral commodities. The main differences include:

1. Geographical concentration: The availability of identified, commercially viable, extractive assets is more limited for this sub-group than other globally traded mineral commodities. Pre-2015, as there was limited global demand for these minerals, mining investments were low, hence the low number of producing assets we see today. In addition, the assets that do exist tend to be limited to a small number of countries, where it is the most economically viable to extract them. Therefore, geographical concentration is a characteristic of most CRM ores.
2. Limited open-market trading: As opposed to the major metal exchanges, in the early period (pre-2015), these minerals were either traded on minor/specialised exchanges or through direct contracts between a buyer and supplier. They were not subject to the same open-market price setting dynamics as the major mineral commodities. This also dampened the transparency of price formation and levels of mineral stock available.[9] This has begun to change, with the LME offering cobalt (cash-settlement) contracts from 2019 and lithium hydroxide contracts from 2021.
3. Product specifications: As with all minerals, the product specification at point of delivery is still determined by level of purity, regardless of where the mineral was extracted and processed. However, customers have more input into the level of processing of the mineral product at point of delivery. For example, customers can specify the size of graphite flakes to be delivered, ranging from +50 mesh (XL) to -100 mesh (small). Therefore, while one aspect of product standardisation is maintained (purity level), customer preference allows for greater product differentiation relative to the traditional mineral commodities.

The differing characteristics of CRM ores create leverage points for governments where these mineral assets are geographically located. The restrictions in access, non-open market price setting and differing product specifications allow for governments to influence supply (both positively and in a restrictive manner). This was not a policy space that was available in the traditional mineral commodities segment.

1.3. The impetus for policy intervention

Within the growth framework characterised by GVCs, linkages and CRM ore characteristics, CRM ore rich governments have been finding greater space for policy intervention than in previous commodity price booms. LMIC governments had gained policy experience in creating investments and growth through participation in GVCs and creation of forward and backward linkages over the past decades. Policy intervention based on this experience has been further spurred by: 1) demand for CRM ore emerging from high-income export markets, and 2) a (domestic) political shift towards resource nationalism.

1.3.1 High-income countries as export markets

The majority of demand for CRM based products is located in high-income countries (EU Member States, Japan and the USA) and in China (upper-middle income country).

[8] In 2023, RE accounted for 30% of the global energy mix (IEA, 2024a), while EV sales accounted for 17.8% of cars sold in the past year (IEA, 2024b).

[9] As a result of limited exchange trading and product differentiation, the prices for these minerals are not always available in the public domain. Prices for the industry actors are largely provided by private services providers. For example, Benchmark Mineral Intelligence through a subscription provides prices for EV battery raw materials.

It is important to differentiate between CRM consumer demand (based on consumption/use of green technology/defence related products) and the CRM ore demand for production (for manufacturing activity of green technology/defence related products).

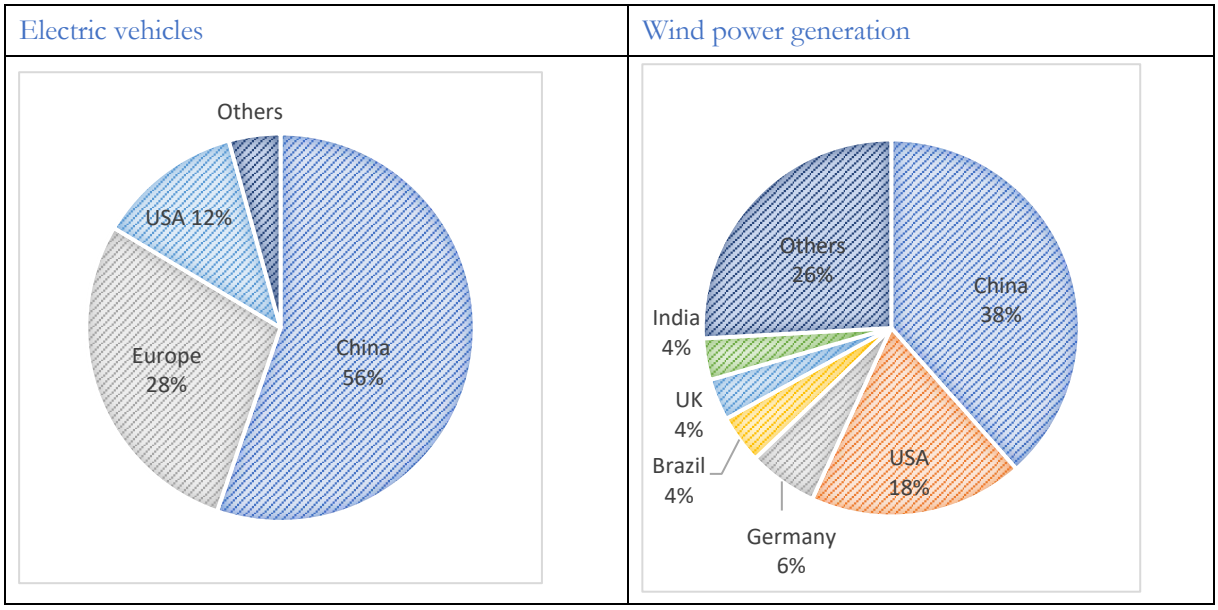
In the first instance, the consumer demand for CRM based products is in high-income countries (EU Member States, Japan and the USA). This demand is being met by some level of domestic manufacturing, but the value chains rely on production in China of intermediate and final goods. This dependency on a single country has led to geopolitical and economic concerns around supply security. In addition, China is also a major consumer of green technology products. As shown by (Figure 2), the consumption of green technology products (EV & RE) is largely accounted by these countries.

In the second instance, there is demand for CRM ores and refined products for manufacturing and production. China is a major producer for some of the CRM ores (lithium, graphite, REEs), as well as the major producer of refined CRM ore products. It meets its domestic manufacturing ore requirements, both through domestic ore extraction and ore imports.

EU Member States, Japan, South Korea and the USA have demand for CRM ores and refined products but limited domestic CRM ore resources or recycled minerals. They are focusing on increasing domestic supply (through mining and recycling) as well as seeking new CRM ore assets in LMICs.

Thus, demand for CRM ores, refined products and final products is originating from high-income countries, in addition to China. Consumption and production by middle and upper-middle income countries (such as Brazil, India and South Africa) inform a small proportion of the demand.

Figure 2 Demand for green technologies



Source: IEA, various publications

The demand for minerals in the 2003-2008 commodity price boom was largely led by China's infrastructure and manufacturing demand. The increase in CRM ore/refined product demand since 2019, is more dispersed between the high-income countries and China. More importantly, the demand profile for the EU/USA is increasing to include ore/refined products and not just the consumption of final green products.

This shift in demand profile has opened high-income countries as export markets. LMICs are seeing this as an opportunity to export medium to high-technology products in the form of CRM refined, intermediate and final products. This is an economically attractive proposition.

Historically, the exports from LMICs to high-income countries are in low to medium-technology products. Some of these exports have been possible under preferential trading schemes such as AGOA (USA) and GSP (EU). The duty-free quotas available allow LMIC producers to be price competitive in USA and EU markets. Without the duty-free access, their exports would struggle to compete with the price offered by more efficient producing countries, such as Thailand and Vietnam in the case of apparel for example.

In the case of processed CRMs (or CRM based manufactured products), LMICs would be able to export high-technology products, without the need for preferential trading schemes. Given the profile of CRM minerals as traded commodities (discussed in the first chapter), the limited supply of these products allows the producer countries to 1) influence price, and 2) face limited competition from other countries. There is no need for preferential access to be competitive in the export market. This offers a unique opportunity to LMICs, where high-income countries are actively seeking access to the mineral-rich country export products, rather than creating an export opportunity through preferential trading schemes.

1.3.2 Resource nationalism

Resource nationalism should be understood separately from a government's efforts to use its mineral wealth to create opportunities for economic growth and development. In common usage it implies the 'changing of the rules' after a (private sector) investment has been made in a mining or industrial project. It is undertaken with the objective to transfer a share of the benefits to the Government. The shift is usually not accompanied by a government contribution to the capital or operating costs of the project.

The historical failure of resource endowments to deliver on economic and social growth for many countries, referred to as the Resource Curse[10], has created a gap between mineral wealth and economic wealth for many developing countries (van Krevel and Peters, 2024; Savoia and Sen, 2021). Development has been stagnating in many resource-rich LMICs which is leading to governments using "… minerals and energy [as] a frequent weapon of resistance against economic inequality in the global South" (Berrios et al. 2011).

Many LMICs are presently struggling with the impacts of the COVID-19 pandemic on their economies, which has been exacerbated by the recent cost-of-living crisis. Greater rent capture of the mineral wealth for citizens has been noted as a major political commitment in recent elections in Brazil, Greenland, Indonesia, Mexico, Panama, Peru and South Africa.

Ostrowski (2023) and others suggest that resource nationalism is a result of governments wishing to acquire a larger portion of the rent generated by the higher mineral commodity prices seen over the past five years. Governments are seeking to change the distribution of existing rents by moving a greater share from international companies to domestic companies (Pryke, 2017; De Graaff, 2011). Previously only the rents from the mining sector were being targeted. Now, rents created by mineral based value-added products are also a target for government policies.

Thus, the impetus for policy intervention has been a combination of the urgency to address sovereign debt burdens, existence of a policy space to intervene, the opportunity of accessing high-income export markets and resource nationalism to support growth in struggling economies.

Summary

The first question this report seeks to answer is: why is the current CRM mineral price increase driving more LMIC governments to seek value-added activity? Linking mineral resource wealth with economic development has been a considered government policy goal for decades. The theoretical framework underpinning the current policy focus on value-addition comes from the greater experience and exposure of governments in dealing with GVCs and developing forward and backward linkages (in the mining sector as well as other sectors).

The reasoning behind the value-added policy interventions lies in the confluence of: 1) the recent price increase for CRM ores, 2) high-income countries as export destinations, 3) the characteristics of the CRM as traded commodities, and 4) resource nationalism as a political motivation. The four create an environment where government policy has more space (relative to traditional mineral commodities) to be exercised.

The next chapter examines this confluence by discussing the definition of CRMs and differentiate between demand and supply-driven CRM policies.

[10] The Resource Curse refers to economic challenges faced by the economy such as an appreciating exchange rate, loss of competitiveness of other sectors, increase in domestic competition for capital, revenue volatility for the government and enclave sector reliance for domestic growth and development. It also includes social elements such as increase in corruption, unemployment and elite capture of resource-rents.

2. Critical minerals & value-added policy

Criticality is a function of availability and access to minerals to support the economic and national security of a country. A critical mineral designation, therefore, can emerge from either the producer or a consumer of a CRM ore and simply indicates the mineral has economic importance for the country. CRM policies therefore can be viewed from two aspects:

- Demand-driven: The demand is coming from economies that lack CRM ore resources and are attempting to secure them from global markets. This includes the EU and the USA who have formulated CRM lists and linked their strategic diplomatic, economic and investment policies to secure supply access. China extracts a significant global share of lithium ore, manganese and natural graphite from within its national borders. In addition to these, it imports CRM ores from other countries. China uses investment (FDI and loans for LMICs) and trade measures (export quotas and licences for domestic producers) to ensure the domestic availability of both ores and refined minerals to support the economic security of its economy.
- Supply-driven: Countries that have geological reserves and extract CRMs, foresee an opportunity to leverage these assets and have formulated CRM policies. Sometimes referred to as strategic minerals, the domestic economy/industrial sector has limited capacity to absorb the materials mined. The minerals hold greater potential for export markets. For example, Australia in its 2023 Critical Minerals Strategy designated aluminium, copper, phosphorus, tin and zinc as critical minerals. The list is based on the importance of these minerals for the global green transition, where Australia has significant geological resources. Ghana has designated lithium as a strategic mineral under its Green Mineral Policy in 2023, allowing for a separate set of rules to be added to its Mining Code to govern lithium extraction. These CRM policies are driven by capitalising their export potential by leveraging supply access to create additional domestic investments.

Therefore, a mineral may be designated as critical from a demand and supply viewpoint. For the importing country the designation is an issue of securing access for economic and national security. For the exporting country it is a strategic commodity that offers greater opportunity to leverage additional investments and export revenues.

2.1 Demand-driven CRM policies

The regional demand for CRMs mirrors the production of green products.[11] China accounts for the greatest increase in RE production, followed by the USA and Brazil. Similarly, for EV consumption the market is led by China, followed by the EU and the USA. Japan and South Korea are increasing RE and EV consumption but are not at the same level as the others (see Figure 2 Demand for green technologies).

China's demand-driven CRM strategy deploys a bundle of umbrella policies under its Belt and Road Initiative (BRI) that target access to CRM ores and other mineral assets in Asia-Pacific, Africa and Latin America. The BRI is a comprehensive trade and investment strategy, which focuses on a range of economic and social activities in potential mineral producing economies. The policy for securing CRMs has developed over decades, resulting in China locking-in access to many of the CRM assets. According to Walsh et al. (2025), between 2000 and 2021, China's official sector commitments were estimated at USD 56.9 billion for transition mineral extraction and processing operations in developing countries.[12]

This has resulted in it establishing a near monopoly over REE extraction and CRM refining capacity in China (Table 1). Increasing export restrictions (tariffs, quotas, licences and prohibitions) have emerged on processed CRMs as well as the on technologies for their processing. Part of the motivation comes from securing supply for its domestic industry and part as a response to wider geopolitical tensions with trading partners.[13]

[11] The EU defines green products as those which use resources more efficiently and cause less environmental damage along their life cycle (EUR-Lex; 2013).

[12] See AidData for a full list of these projects by country, mineral and type of commitment.

[13] See Critical Metals will be a Key Battleground for a US-China Trade War (Reuters, 18 December 2024) for more details.

Table 1 China's CRM refining capacity & restrictions

CRM	Share of global ore extraction	Share of global refining capacity	Export restriction
Cobalt	-	68%	Export duties
Lithium	17%	72%	Export restriction on lithium processing technologies
Manganese	6.8%	90%	Export tariff on processed manganese (2023)
Natural graphite	79%	100%	Export licensing (2023)
REE	70%	87%	Export licensing and ban on processing technology exports (2024)

Source: Various publications

The increasing concern of the EU, USA and other governments around supply security in the face of Chinese domination of upstream segments of CRM value chains (ores, smelting & refining), have focused their diplomatic and investment efforts on securing CRM ore supply access. At the international level, these countries have negotiated International Mineral Partnerships and Memorandums of Understanding (MoUs) with CRM ore rich countries (Table 2 highlights some recent examples). The agreements include offers for advancement of value-added activities and infrastructure projects.

For example, to support the objectives of the European Green Deal under the Global Gateway initiative, the EU is offering financing and investment in sustainable projects and infrastructure, in return for access to CRM ore deposits (that have the commercial potential of being extracted). There are commitments to transfer RE and EV technologies and skills development to host countries. The Minerals Security Partnership (MSP), a USA led alliance launched in 2022 with 14 members and the EU, was created to catalyse public and private investments in CRM ore supply sources and to diversify dependence away from China. The partnership includes promoting investments in CRM mining and processing projects and exploring innovative financing mechanisms.

Table 2 Select list of MoUs and Mineral Partnerships for CRMs

Year	Partners (Demand)	Partners (Supply)	Partnership
2023	China	DRC	Comprehensive strategic cooperative partnership
2023	China	Zambia	Comprehensive strategic cooperative partnership
2022	EU	Namibia	Strategic partnership on Sustainable Raw Materials Value chains and Renewable Hydrogen
2023	EU	Chile	EU-Chile Strategic Partnership on Sustainable Raw Materials Value chains
2023	EU	Kazakhstan	EU-Kazakhstan Memorandum of Understanding
2023	EU	DRC	Strategic Partnership Critical Raw Materials Value chain
2023	EU	Zambia	Strategic Partnership Critical Raw Materials Value chain
2024	EU	Australia	Bilateral partnership to cooperate on sustainable critical & strategic minerals
2022	USA	DRC, Zambia	Trilateral MoU on electric vehicle battery value chains
2023	EU/USA	Angola, DRC, Zambia	MoU to support the "Lobito Corridor

Source: Various publications

Of the many initiatives under way (as listed in Table 2), three common threads are noted, which have relevance for this report:

1. The strategies include commitment to financing being made available for potential CRM mining and refining related projects. Blended finance, combining public and private funds, is the major stream of financing being offered. However, for investment projects in non-EU and USA regions, there is an underlying requirement that the funds are available for companies registered in the EU/USA.[14] This limits access by African, Asian and Latin American companies to acquire funds for CRM value-addition projects.
2. The strategies include a commitment to creating value-added opportunities beyond the extraction stage. The focus of these commitments is largely noted for EV value chains focusing on creating battery materials (such as cathodes), manufacturing batteries and manufacturing e-bikes. But the emphasis on commitments to EVs, relative to wider industrial value-added opportunities, carries risks: 1) EV battery technology is complex, and successful projects outside of China are few and far between. Raw material availability is not enough to overcome the technological and capital requirements for these operations. 2) A market analysis of the ability to absorb EV and RE technologies in high-income countries as well as African and Latin American markets has not been established. As noted, the uptake of RE and EV is limited in LMICs at this time. This sets up any EV/RE value-added activity to become export dependent on EU and USA markets. Export orientated industrialisation can quickly become an enclave sector not embedded (through meaningful linkages) within the wider industrial sector in the country.
3. Commitments include technology transfer and skills development in RE and EV sectors for partner countries. However, an assessment of whether these technologies are suitable for the economic and social context of the partner country, as well as its governance capacity and structures has not been clearly established. Partner countries are at different stages of industrial development and experience energy poverty and water stress. While RE technology is much needed to combat climate change impacts in these countries, the transferred technology needs to be suitable for the domestic context.

   For example, in interviews it was pointed out that the green hydrogen projects being encouraged in some African countries are not aligned with the environmental context of these countries. Green hydrogen production is a water intensive process, and several African countries are already experiencing water stress. In addition, the capacity of regional consumers to use green hydrogen as an energy source is limited, thus the product tends to become export orientated (EU destinations). While this creates a valuable source of foreign exchange, it creates the same challenges as other export dependent industrialisation projects.

2.2 Supply-driven CRM policies

As a response to the increased CRM ore supply security concerns, governments in CRM ore rich LMICs are seeing an opportunity for industrial FDI. Given the specific context in which CRM ore supply access is being sought by high-income countries, the policy objectives for some governments focus on leveraging their assets in return for value-addition investment projects and support. It is pertinent to mention that not all CRM ore rich countries have sought to leverage their assets through restrictive trade/investment policies but continue to maintain their mining/industrial policy as is in line with open-market principles.

The discussion below focuses on those governments specifically seeking expansion in domestic value-added activity and strategic development of green technology sectors by leveraging access to their CRM ore assets. The three common objectives[15] noted within their CRM strategies are:

1. Vertical integration: The pursuit of vertical integration aims for an expansion in higher value-added activities of particular products. Policies focus on fostering smelting and refining activity in addition to

[14] A more thorough review of the policies is required to articulate the conditions for access to funds for non-EU companies, under the Global Gateway as well as the MSP funding. In interviews, the impression for LMIC stakeholders is these initiatives isolate African and Latin American head-quartered firms from accessing funds, and therefore the MSP and Global Gateway are a continuation of the 'traditional' engagement by the advanced countries, only dressed up differently.

[15] The policy objectives are a means to address unemployment, increase FDI, improve skills and technology transfer and produce linkages with the wider economy.

the mining activity. Vertical integration policies also consider the establishment of first-tier intermediate product manufacturing (such as EV battery cathodes and other materials) as well as the establishment of final product manufacturing (such as e-bikes). For example, in 2023 Ghana successfully negotiated for a lithium refinery to be established as part of the licensing agreement for a lithium mine (BHRRC 2023).

2. Strategic sector development: Countries are seeking to develop wider strategic sectors. For example, in 2023 the Democratic Republic of Congo (DRC) and Zambia signed an MoU with the USA, where the latter will provide support for the development of an integrated value chain for EV batteries in the DRC and Zambia, including processing, manufacturing and assembly (U.S Dept. of State, 2023). Strategic sector development is in addition to vertical integration and focuses on industrial activity that involves multiple intermediate product and service providers. For example, EV batteries involve cathode and anode producers, other chemicals and component producers, assemblers, equipment and service providers, laboratory testing services and transport specialists etc.
3. Securing domestic supply of raw materials: CRMs, before they were designated as 'critical', were already being used in conventional industrial activity such as steelmaking. In response to an increase in CRM demand (and price), governments are attempting to ensure their own mineral supply security for their domestic traditional industries/consumers. For example, in 2023 India placed chromium ore exports into a restricted category to ensure its domestic steel industry had access to domestically-mined raw materials.

Geological concentration of ores is not always a determinant

In Chapter 1, geographical concentration was noted as a characteristic of CRM ores. In some cases, a mineral may be considered critical even where its extraction is not impacted by geological concentration. This allows for demand and supply-side CRM policies to emerge for minerals that may not necessarily exhibit geological concentration.

For example, manganese has been designated as a critical mineral by the EU, yet is mined in more than 30 countries[16], with little extraction concentration amongst the largest producers. In 2023, while the top three mining countries accounted for 75% of total production, none held a monopoly over supply: South Africa (36%), Gabon (23%) and Australia (15%). Copper, designated as a strategic mineral by the EU, is extracted at over 700 mines globally, with Chile accounting for 27% of global copper extraction, followed by Peru, DRC, China, USA and others. No country monopolises global copper ore production.

For other CRMs geological concentration is a factor. There are 34 globally active lithium mines noted, with Australia accounting for 44% of global supply, followed by Chile (23%). For graphite, there are 70 known active mines, with China accounting for 60% of natural graphite extraction, with Madagascar, Mozambique and Brazil accounting for less than 7% each. Therefore, companies seeking to extract either lithium or graphite are limited in their choice of investable jurisdictions due to geological concentration.

Other CRMs extraction, such as cobalt and gallium, are based on a primary mineral (such as copper and zinc respectively) and are hence rarely mined as the primary product. Therefore, copper and zinc mining companies will be considering the commercial profitability of the copper and zinc operations; the by-product credits from cobalt and gallium are simply included in the company's commercial viability calculations. For example, in the DRC cobalt is a by-product of large-scale copper mining.[17] With its high-grade copper deposits it is an attractive investment destination for mining companies. Should the copper extraction be deemed unfeasible, large mining companies would not invest in cobalt extraction alone in the DRC. Geological concentration is therefore linked to the primary mineral and not the CRM. Geological concentration may not always be a unifying characteristic of CRMs – some are affected by such concentration, while others are not.

Summary

A mineral is designated as a 'critical' mineral based on its importance to the national economy. CRMs are important to importing countries for their national and economic security. For exporting countries their

[16] IMnI (n.d.) About Manganese <accessed 16.08.2024>.

[17] According to Katz & Maiotti (2021), large scale mining accounts for 70-80% of cobalt production in the DRC.

importance stems from their export potential and the ability of governments to leverage them for additional investments.

China has a strong position in CRM upstream value chains and is increasingly using export restrictions to control global supply of refined products. To create their own access to CRM ores and refined products, demand-driven CRM policies from the EU, USA and others have focused efforts to engage with CRM ore rich LMICs. These efforts have included commitments to value-added activities and investments in return for access to CRM ores.

Objectives of LMICs supply-driven CRM policies are focusing on vertical integration and strategic sector development, partly in response to the incentives being offered under demand-driven CRM policies.

A successful alignment between demand and supply-driven CRM policies should result in importing countries seeking supply security to meet their objectives and in exporting countries seeking value-added investments to do the same. In reality, this is not the case for most.

The next chapter turns to GVCs and linkages concepts (introduced in Chapter 1) and outlines how supply-side CRM policies are being operationalised in practice.

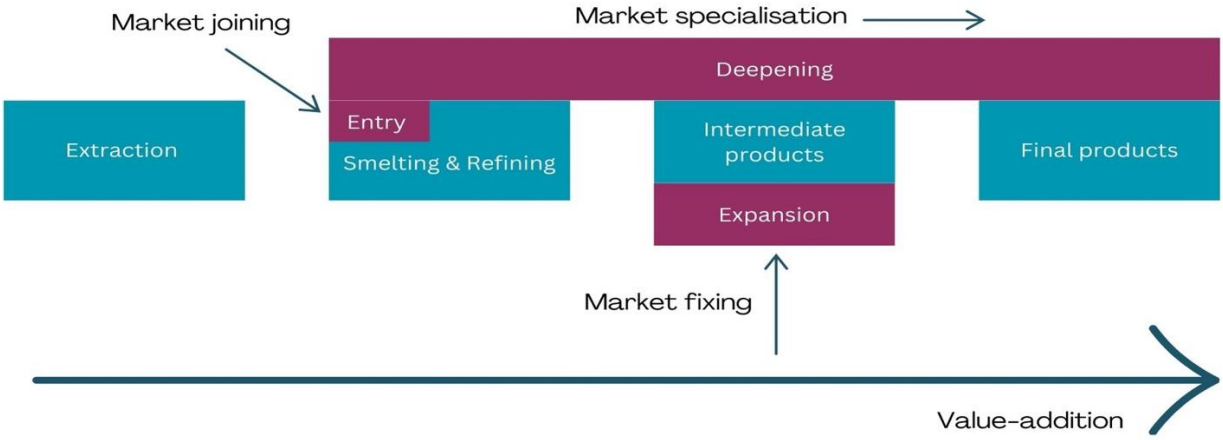
3. Value-addition through a GVC framework

China has dominance in the upstream segments of CRM product value chains, accounting for a major share of global ore imports of these minerals, and the smelting and refining of these ores. For countries, like the USA and the EU member states, seeking to develop capacity in the downstream segments of CRM product value chains, such as production of EV, RE products, defence equipment, the reliance on China's processing poses a supply disruption risk. To mitigate this risk, the focus of their demand-side CRM policies has been to access new sources and capacities in the upstream segment of CRM value chains beyond China.

For supply-side CRM policies, this has created opportunities for CRM value-added investments. A review of policies indicates this is being approached under a GVC framework. Figure 3 offers a simplified approach to illustrate the various forms of GVC participation being considered by LMICs and includes:

1) Market joining: Enter a GVC by joining a particular node in the value chain as first-entrants. A node is generally involved in the manufacture of a single product.
2) Market fixing: Expanding existing operations within a GVC by increasing production volume and/or the number of firms. This category is associated with a single node and will generally focus on the production of a single product.
3) Market specialisation: Deepening operations within a GVC by expanding into further nodes (both upstream and downstream) along the value chain. This expands into near-by nodes and can additionally involve more linkages being formed with the domestic economy. Generally, this can be considered as sector development rather than a single product integration.

Figure 3 Participation opportunities within a mineral value chain



Source: Authors compilation

Each of these objectives requires the consideration of the existing domestic capacity of the economy as the starting point for the policy intervention. Based on Figure 3, and for ease of discussion, we use these three starting points to illustrate this, accepting that in practice these operate across a spectrum rather than the implied compartmentalisation. For each discussion, an example is offered to illustrate policy implementation. However, as CRM policies are relatively new and very few have led to value-added investments, we use examples of other base minerals to elucidate the three approaches.

3.1 Market joining by entering GVCs

The policy objective is to enter a green product GVC, where no previous domestic capacity exists or is minimal. Based on its mineral resources, the government is seeking to participate in a GVC, in which domestically located (but not necessarily domestically owned) firms will participate.

The policy aims to address the failure of domestic capacity to emerge under existing (national and international) market conditions. The policies will aim to attract FDI and international first-mover firms. The Key Performance Indicator (KPI) for the policy mix would be the entry of a value-adding firm in the domestic market. This is achieved through two avenues:

1. Decrease the costs for domestic operators: To improve the cost competitiveness of domestic producers, relative to international competitors, domestic actors are afforded access to cheaper raw materials, tax incentives, and lower customs duty on imports of machinery etc. The aim is to provide a cost subsidy.
2. Increase the domestic volume of raw materials/intermediate products: The policy focuses on improving competitiveness through ensuring access to raw material product volumes for domestic producers. By introducing restrictions on export of ores/smelted products/intermediate products, the domestic price is lowered. The domestic manufacturer has assured domestic material supply and does not need to compete with international competitors to secure access.

Mongolia's policy approach to copper value-addition

Mongolia has high-grade copper deposits and is an emerging mining jurisdiction, starting copper ore exports in 2013. Between 2015 and 2022, Mongolia's copper ore exports have increased by 20% and the exports of refined copper products by 30% (WITS, 2024).

Its industrial policy provides for preferential treatment for domestic value-addition and backward and forward linkages (by encouraging use of domestic firms and goods). Mining companies are required to supply ores and concentrates to domestic processing facilities and sell mineral output on the Mongolian Mining Products Commodity Exchange at global market prices. Since 2011, the government applies a tax on the exports of unprocessed copper as well as molybdenum ore and concentrates.

Two free-trade zones have been established in 2004, offering tax and customs incentives. However, the zones are reported to be relatively inactive. There are no explicit investment policies providing incentives for FDI in value-added activity in the copper value chain. No other quota, licencing or tariff requirements or incentives are noted.

The KPI for market joining, i.e., entry into a GVC has been achieved, as both ore and processed copper exports have increased. However, while these numbers suggest a positive outcome, they should be interpreted with caution. Data on the number of copper smelting and refining units in Mongolia is largely unavailable – and the literature review failed to track down refining companies in the country. The review did indicate that Mongolia exports up to 90% of its minerals without processing. The inability to generate processed materials was attributed to limited domestic capacity, lack of capital and value-added technology (Krusekopf, 2023). Therefore, while successful market joining is noted, further government policy will be needed to support this fledgling industry in Mongolia.

3.2 Market fixing by expanding within GVCs

The policy seeks to expand the value generated from an existing industrial activity or value chain node. Market limitations are hindering the growth of the segment. For example, while mineral extraction volumes have trended upwards, the volume of refined materials has stagnated or plateaued. The policy objective is to address the market limitations that are causing stagnation or limiting growth, so the existing industry expands. This is expected to be achieved through economies of scale and/or increasing the number of firms operating domestically.

Market limitations can be dependent on a number of challenges, such as scaling issues (firms do not have the required competency or capital to scale-up production); individual firm competitiveness (capital productivity levels remain low); enabling factors within the domestic economy (availability and cost of energy, water, capital, infrastructure etc inhibit growth); or technological complexity (firm is unable to procure more efficient machinery and labour).

The first-best solution would be for government policy to directly address the market limitation. For example, if firm cost competitiveness is an issue, policy should focus on improving access to capital, increasing availability and access to utilities, and improving infrastructure and customs facilities.

In the absence of first-best solutions (which directly address the market failure) the government instead turns towards second-best solutions (e.g. raw material policy, which indirectly address market failures). For example, attempting to improve firm cost competitiveness through making raw materials cheaper in the domestic market by using export tariffs or prohibitions.

Within GVCs the policy intervention will vary, dependent on the market failure identified. Generally, the policy will aim to:

1. Improving domestic raw material flows*:* provide competitive advantage by diverting some of the raw material flows destined for foreign companies (via exports) to the domestic value-added producer. The diversion is meant to:
   i. Increase the availability of raw materials for the domestic producer as well incentivising scaling-up and increasing output.
   ii. Where the country accounts for a significant share of the global mining production, the export diversion could increase international prices and reduce mineral access for foreign competitors. At the same time, the domestic producer would have greater mineral access at lower prices.
2. Improving cost competitiveness*:* factors such as the cost of energy and water, infrastructure availability, corporate taxes, import duties on machinery etc. can impact the cost competitiveness of firms. To support domestic producers, governments will attempt to improve competitiveness (particularly through the creation of Special Economic Zones (SEZs)) to offer a lower fiscal burden and improved administrative facilities etc.

While these measures seem similar to the ones noted before, the KPI for success is different. 'First-movers' are already present. The objective is to increase the number of firms and/or the volume of production.

Zimbabwe's quest to build a smelting & refining sector

Zimbabwe holds high-grade platinum and chromium ore deposits and is considered a relatively mature mining jurisdiction. With some refining capacity already present in the country, this example illustrates the case of market fixing.

In 2021, export prohibitions were imposed on chromium ores and concentrates to be fully implemented in 2022. At the time of announcement, Zimbabwe had 22 ferrochromium producers. According to Perry et al. (2024), the prohibition achieved its intended objective – the volume of domestic ore sent to downstream production increased and the price of domestic ore fell by 10.53%. The volume of ore made available to the domestic market increased by 10.21% (see Table 3). This resulted in domestic production of ferrochromium increasing by 16.58%. However, the table also highlights the opportunity cost of the export prohibition. With the domestic market unable to absorb the entire mineral output, and mining companies faced with a lower price for their product, volume of domestic ore decreased by nearly 43%.

Table 3 Estimated economic effects of the 2021 Zimbabwe chromium ore export ban

Variable	Estimated effect (% change)
Price of domestic chromium ore	-10.53
Volume of domestic ore sent to downstream production	10.21
Volume of domestic ferrochromium	16.58
Volume of domestic ore production	-42.67
Price of domestic ferrochromium	-4.96

Source: Perry, Schreiber and Guberman, (2024

A closer look at the role of industrial, trade and investment policy in this case study suggests that the success – the increase in local downstream production – can be largely attributed to the strategic needs of an external actor (China), rather than the effectiveness of the government's policies.

The Zimbabwe National Industrial Development Policy (2009-2023) aimed to increase value chain participation by domestic firms in a number of sectors (including mining, pharmaceutical, agriculture and the fertiliser sectors). Local content policies were also drafted, requiring the use of domestic goods and services. However, firms reported non-availability of key raw materials in the domestic sector, low product quality of inputs produced within the country and high prices of local inputs as compared to imports. The policies were found to be largely ineffective as complementary strategies, regulations and frameworks to implement the policy had either not been drafted or were considered too vague to be effective.[18]

[18] Source: Resource Nationalism in Southern Africa (2024).

Zimbabwe's investment policy, which does not place regulatory limitations on foreign investors, was also noted to lack the mechanisms or formal structures to negotiate with investors (US Dept of State; 2023). The SEZ that had been set up (offering tax incentives and one-stop-shops) largely failed to attract investors. Administrative delays and costs (particularly at customs), corruption, lack of access to a stable electric supply and improving domestic financial institutions capacities were noted as major hinderances to investments.[19]

The China effect

Zimbabwe has attempted to force beneficiation previously, through high tariffs and export prohibitions in 2011. Limited domestic absorption capability by the industrial sector allowed the mining companies to negotiate the withdrawal of the announced ore export prohibitions. The difference between the 2011 and 2021 export prohibition was that the majority of the 22 ferro-chromium smelters operational in the country were owned by Chinese companies. Given China's strategic interest in stainless steel value chains and maintaining their Zimbabwean chromium ore access, the 2021 export prohibition was accepted as the cost of doing business by these operators. To continue to maintain this access additional investments have also been announced, including the establishment of a new steel plant, with an estimated investment of USD 1 billion[20], with production beginning in 2024. The successful achievement of the KPI of additional firms in the domestic market can be attributed to Chinese determination to continue operations, rather than the effective role of industrial or investment policies.

3.3 Market specialisation by deepening GVC participation

Two major policy objectives can exist under this scenario. Broadly, these will address: 1) creating higher value-added activity within the GVC by expanding into adjoining value chain nodes, and/or 2) deepening forward and backward linkages from the existing production node. For clarity, a GVC encompasses several nodes of production. Linkages are not part of the GVC itself, but supply to or purchase from a production node in the GVC.

The government faces a situation where existing market conditions have led to certain core competencies being established within the domestic economy. But the domestic actors have been unable to capture further downstream activity. Another situation, which can exist in parallel to the first, is that forward and backward linkages have not deepened from the existing GVC node.

Within the context of this report, a review of supply-side CRM policies suggests LMICs have chosen to pursue market specialisation at a project-by-project basis, rather than adopt a wider industrial sector approach. This has resulted in LMICs directly negotiating investment projects with high-income countries and China, in response to the supply security led mineral partnerships and MoUs. The nature of these projects can differ widely, depending on whether creating higher value-added is the primary objective or the deepening of backward and forward linkages. The KPI for this policy is the establishment of an investment project, preferably as part of a larger industrial park/SEZ to spur further investments.

The market specialisation category differs from the previous two GVC participation approaches in one key aspect: the participation is largely driven by capitalising on strategic factors rather than economic factors. Strategic factors within this report's context centre on the access to extractable CRM ores. While this will differ for each mineral within the CRM catalogue, in general the limited availability of extractable minerals (due to either geographical limitations, or geopolitical factors) makes CRMs a scarce resource. Here, these strategic considerations carry more weight than economic factors which focus on the cost of extraction and transport, roughly summarized as the factors that go into the bankable feasibility assessment of a project.

Negotiated project agreements

Negotiated project agreements are undertaken between a government and an international company (or a consortium of companies). It is a means to facilitate FDI, with a narrow focus on a single investment project. Such agreements will be undertaken for projects that have high capital costs for the investor and would have unlikely emerged in the host country through market forces.

[19] Financial institutions are a major source for raising domestic capital. In addition, they offer other services important for businesses such as offering affordable credit lines and insurance products.

[20] Production begins at Tsingshan's USD 1bn Zimbabwe Steel Plant. (Mining Technology, 21 06 2024)

Negotiated agreements are also used when the national regulatory framework is too weak to attract investments. Its advantage is in allowing the negotiations within the parameter of a single project, without having to impact wider sectoral regulations.

For example, given the technological and fiscal feasibility studies for the project, the project agreement will capitalise on its strengths and compensate for its weaknesses. This may involve particular fiscal rates, exemptions from duties or local content requirements.

For the LMIC government, the political motivation is often the pace at which these negotiations can progress – they are quicker to resolve, relative to changing, costing and implementing national policies and strategies. However, transparency is a challenge in project agreements and is often viewed as an avenue ripe for corrupt practices.[21]

The negotiations can take time and are often interrupted by election cycles. But once agreements are finalised, projects are operationalised quickly. Well-written contracts will also include dispute settlement and arbitration measures. Once operational, these agreements usually contain stability clauses, which limits the nature and level of changes allowed over a period of time. This can be an advantage for investing companies, as it provides stability to the producer. It can be a disadvantage if the external conditions change materially but the contract does not offer flexibility.

Ghana's strategic project approach

Ghana's first lithium mining lease agreement was signed in 2023 for the Ewoyaa Lithium Project. Through negotiations with the mining company, the agreement includes a higher tax rate (10% royalty rates relative to the 5% in the legislation) and state participation in the company (13% equity stake relative to the 10% in legislation). In addition, mineral processing is required under the lease agreement – with a lithium refinery project announced in 2024, to be operational by 2026. It is estimated that half of the lithium extracted from the mine will be processed by the refinery. In addition, there are indications that lithium extracted in Zimbabwe will also be processed by the Ghanian refinery. Apart from international investors (Piedmont Lithium and Atlantic Lithium), financing for the Ewoyaa lithium refining project is being raised through domestic markets (stock exchange listing) as well as financing from the Ghanian Sovereign Minerals Fund.

Instead of using its existing industrial, investment and trade policies, Ghana used its Green Mineral Policy (2023) to address green technology minerals, leaving gold production and exports out of its scope. The Green Mineral Policy provided for the prohibition of exports of lithium, bauxite and iron ore and concentrate, unless specific conditions (related to beneficiation) were met. In addition (and outside the scope of the Green Mineral Policy) project specific investment for the refinery was provided by the government. The project agreement was also a negotiated process outside of the traditional mining legislation (it will receive parliamentary ascent to provide legal cover). The strategic project approach, using elements from the Green Mineral Policy and stand-alone project capital contribution, stepped away from the use of mainstream industrial, investment and trade policy. Instead, the government secured a CRM mining and value-addition contract through direct negotiations.

Summary

Participation in GVCs in general, is determined by a firm's cost competitiveness. In the case of market joining and market fixing approaches, governments are attempting to provide cost subsidies or increased competitiveness through preferential access to raw materials and lower domestic prices. In the case of market specialisation, strategic interests become a driving factor.

In the case studies in this chapter, we note a dominant use of trade policy in supply-driven CRM policies with the objective of driving domestic value-addition activities. The export tax (in the case of Mongolia) and export prohibitions in the case of Zimbabwe and Ghana have been used to 'force' value-addition in the domestic sector. Zimbabwe's performance on accompanying industrial and investment policy has been weak – implementing structures have either not been drafted or been ineffective. Ghana, with its more focused strategic project approach, has been more successful in creating a value-added refinery without disadvantaging its domestic ore production.

The case studies also noted a focus on GVC participation, whereas the creation of forward and backward linkages have been largely ignored. Addressing the capacity of the existing industrial, economic and financial

[21] For example see Scurfield & Gyeyir's Assessment of the Fiscal Regime in Ghana's Lithium Agreement (2024)

structures to support linkages, also referred to as the enabling environment, is not seen as a policy objective. The creation of SEZs (which provide tax and customs incentives) are assumed to address this issue. This is not always successful.

The use of trade policy without accompanying potent industrial and investment policy, is a major flaw in the supply-driven CRM policies in LMICs. The next chapter examines the ideal mix of these policies to effectively support value-addition in CRM related GVCs and formation of linkages.

4. Effective policy mix for value-addition investments

Supply-side CRM policies tend to use GVCs and creation of linkages as foundational policy frameworks (Chapter 1). In drafting industrial, investment and trade policy, cognisant of these frameworks, certain characteristics of green product GVCs need to be kept in mind.

Policies need to be considerate of the cross-border structures and how country endowments determine GVC participation. Fernandes, Kee & Winkler's (2022) study of over 100 countries involved in GVCs indicated that the key determinants of country participation, in order of importance, were: factor endowments, geographical location, political stability, tariff and FDI inflows as well as domestic industrial capacity.

Policy considerations need to weigh the technology requirements of the green product vis à vis the existing domestic sector capacity. Green products, particularly EV batteries, tend to be highly complex not only in the technological requirements but also the required operating conditions. They are capital intensive, requiring high-skilled labour and ancillary services as well as efficient logistics to function. Compared to low-technology products (such as clothing) these products are energy and water intensive. Policy drafters need to be cognisant of the core competencies available in the domestic sector that can be transferred to green products. The domestic capacity of the economy to support the formation of forward and backward linkages needs to be identified. In addition, the availability and cost of utilities has a large impact on firm cost competitiveness and needs to be included in value-addition policy considerations.

Another factor is the understanding of the governance structures of green product GVCs, which are multifaceted relationships between lead firms and their suppliers.[22] Most lead firms assert significant technical and governance control, dictating the qualification requirements for suppliers and their operating standards to be eligible for participation in their chains (Leruth *et al.*; 2022). Therefore, GVC participation and development of linkages is not limited to engagement with a particular tier supplier, but also the lead firm of that value chain.

In the wider governance context, conditionalities under international mineral partnerships and MoUs will also come into play. The international partnership conditionalities, noted in Section 2.1, have geopolitical undertones for sourcing minerals and firm qualification criteria for capital disbursement.

The second question this report sought to explore is what policy tools governments are using to achieve their objective of creating CRM related value-added activity. The previous chapter presented examples of supply-side CRM policies in selected countries. This chapter focuses on the assessment of such policies (industrial, investment and trade policies) originating under supply-driven CRM policies. The assessment moves away from a GVC focus (joining, fixing, specialising) and instead focuses on enabling factors and the policy mix. Where possible, examples from CRM (or suitable base metals) are provided for illustrative purposes.

Assessing policy effectiveness through the company decision lens

Demand and supply-side CRM policies have been announced over the past five years and their implementation is still on-going. Not enough time has lapsed to warrant an assessment of their effectiveness based on national industrial or trade data. To assess effectiveness this chapter instead uses a company's point of view – whether the tools deployed under a CRM policy would encourage or discourage investments.

Demand-driven CRM policies are dependent on companies (whether publicly or privately held) to meet their supply security objectives. Mining companies, whether in Africa, China, Europe or Latin America will operate under some version of an 'off-take' agreement: a medium to long term contract that specifies the client and the volume to be delivered. The off-take agreement ensures mineral ore supply to smelters and refineries. Securing access at the upstream segment of the GVC supports security in each successive segment. In very few cases will CRM ores be available on the open market.

Demand-driven CRM strategy objective is for their smelting/refining companies (and intermediate product manufacturers) to secure off-take agreements with mining companies to meet their economic and national security requirements. To achieve this, the governments will assist new mining companies to be established

[22] For Renewable Energy Chains see Kugerl & Tost (2021); E-Mobility Chains see Betz, Degreif & Dolega (2021) and Electronic Equipment Chains see Gonzales & Schipper (2021).

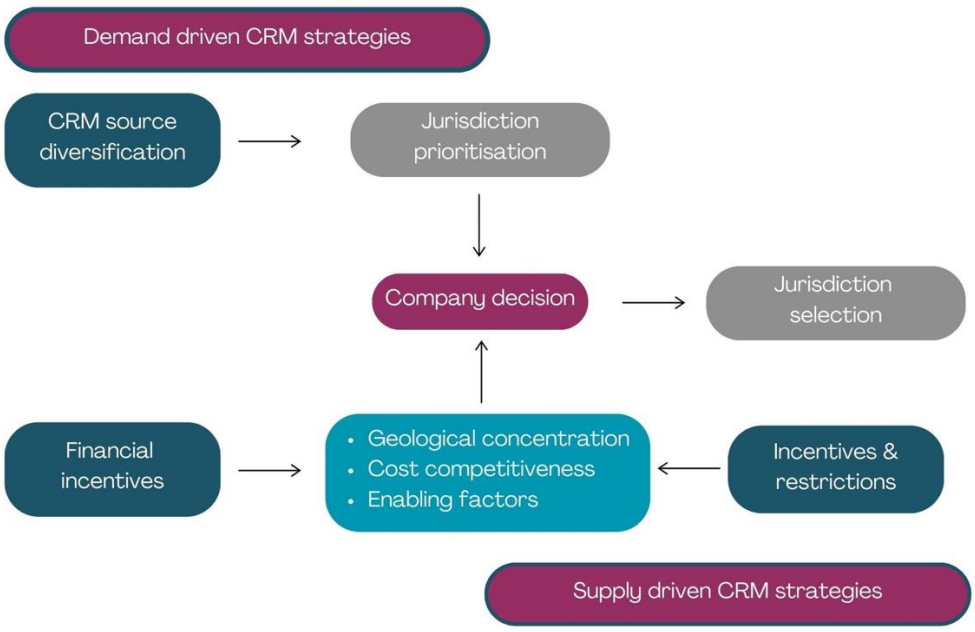
in LMICs through diplomatic and political measures, including arranging investments in other value-added activities and infrastructure projects.

Supply-driven CRM policies also target mining companies. For granting access to their CRM ores (through mining licences and export conditionalities), governments are seeking additional investments in value-added activities and/or strategic sector development. The companies will be ultimately responsible for investing in value-added projects – whether they be in smelting and refining, intermediate or final products.[23]

The connection between these demand and supply-side CRM policies on a company's behaviour is illustrated by Figure 4. Demand-driven CRM policies prioritise ore source diversification, taking into account geological concentration of commercially viable potential mining sites. This influences which countries are to be prioritised or preferred as international partners. Companies, in response to this jurisdiction prioritisation, take into consideration cost competitiveness of setting up operations and enabling factors within these jurisdictions. The financial incentives available under the demand-driven CRM policies will further inform this analysis.

From supply-driven CRM policies, companies consider the impact of the enabling environment, trade and investment incentives or restrictions in the prioritised jurisdictions on their ability to conduct business. Based on the assessment, informed by both demand and supply-driven CRM policies, the company will make its decision on the best available jurisdiction to invest in.

Figure 4 Demand and supply-driven CRM policies and company decisions



Source: Author's compilation

The simplified decision-making framework offered in Figure 4 reinforces the following point: both demand and supply-driven CRM policies influence company decisions. Incentives and restrictions from both policies inform a company's choice to locate CRM investments in a particular jurisdiction.

Further analysis of demand-driven CRM policies is outside the scope of this report. The next section breaks down industrial, investment and trade policy elements within supply-driven CRM policies and how they impact company decisions. Elements that encourage companies to invest are assessed to be effective tools in a supply-driven CRM strategy. Geological concentration is assumed as a given in this discussion on CRM – as jurisdiction prioritisation will already have accounted for the presence of economically viable CRM ores that can be extracted.

[23] There are, of course, market driven corporate factors that inform choice of operations and the country of investment. However, for this discussion we take these as given, and not warranting further discussion.

4.1 Industrial policy & the enabling environment

Participation in GVCs and forming linkages is usually prescribed under industrial policy. For CRM ore rich countries, the policy targets may mention the particular mineral value chain to be targeted, the green product sector to be prioritised or specify the local content targets amongst others. A quick review of the available industrial policies of CRM ore rich governments (Table 4) across different income groups, notes different approaches to address value-addition. These include strategic plans, use of legislation and the creation of strategic mineral lists for specific attention.

In reviewing industrial policy documents for LMICs, the supplementary structures, regulations and required policy cohesion to translate objectives into implementable policy is often found to be missing. What is more commonly noted is the use of trade policy to deliver the industrial policy. The supporting industrial and investment structures required are often noted to be more limited or non-existent.

Table 4 Examples of CRM related industrial policy targets

Year	Country	Title	Type
2021	Malaysia	National Mineral Industry Transformation Plan 2021-2030	Strategic plans, Framework legislation, Strategic mineral lists
2016	India	Critical Non-Fuel Mineral Resources for India's Manufacturing Sector	Strategic plans, Framework legislation, Strategic mineral lists
2021	Colombia	Policy for Reactivation, Revitalisation, and Sustainable and Inclusive Growth	Strategic plans, Framework legislation, Geological surveys, Incentives and investments
2021	China	14th FYP for Raw Material Industry Development	Strategic plans, Framework legislation

Source: IEA Critical Minerals Policy Tracker <accessed 4.01.2024>

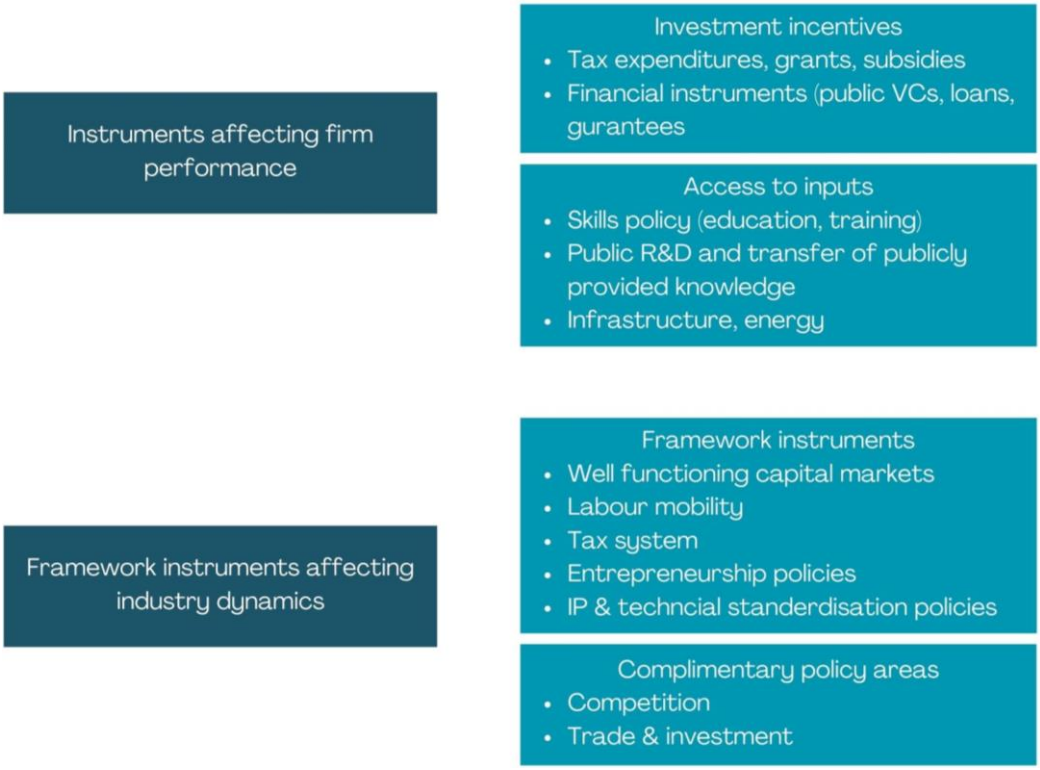
Industrial policy should leverage instruments that impact: 1) the firm performance, and 2) the wider framework within which the firm operates. As noted by the OECD, the industrial policy tools that can be employed address firm performance through investment incentives and access to inputs; and industry sector performance through framework instruments which include capital, labour and entrepreneurship facilitators (Figure 5). Together these impact the cost competitiveness calculations for a firm and the enabling environment to conduct business and industrial activity.

Firm and industry sector performance requires the provision of a skilled domestic workforce, access to technology and further research and development (R&D) facilities plus infrastructure and transport corridors, including well-functioning ports. Utilities, particularly access and affordability of energy and water, also come within the remit of industrial policy.

Other framework requirements refer to more intangible inputs, such as the regulatory framework, administrative burdens or bureaucratic procedures within which the GVC/linkages will operate. For example, the World Bank's B-READY (2024) report, categorises these enabling factors under three pillars:

- Regulatory: rules and regulations applicable to a firm in starting, operating and closing a business
- Public services: facilities that support regulatory compliance, institutions and infrastructure enabling business activities
- Operational efficiency: ease of compliance for the firm with the relevant regulations and in using public services offered.

Figure 5 Supply-side industrial policy instruments



Source: Adapted from OECD Taxonomy of Policy Instruments <accessed 17.12.2024>

South Africa, PGMs & autocatalytic converters

South Africa is a major producer of PGMs, which are used in high-technology sectors. In 2011, a large share of the country's domestic mineral production was under off-take agreements with international auto-catalyst manufacturers. Under the South African Mineral Beneficiation Policy (2011) objectives, industrial policy focused on creating domestic auto-catalyst production. The actions under the policy included engaging with mining companies to manage the availability of PGM supply for domestic producers, developing R&D programmes, alignment of existing skills development and tasking the Automotive Production and Development Program (APDP) to promote investments and design incentives. By 2016, catalytical convertors had become the single largest export product from South Africa.

In addition, the domestically produced convertors were also feeding into the domestic automobile GVCs, which supplied assembled vehicles to both the domestic and international markets. While the development of the catalytic convertor sector has not been without its external and internal challenges, the comprehensive nature of the beneficiation plan/industrial policy was immensely valuable in developing value-added capacity in the country.

From a company's perspective, the Beneficiation Policy (2011) authored by the government, addressed a number of issues that impacted its cost competitiveness and did not focus on an isolated policy tool (Table 5). It acknowledged the cross-cutting constraints to beneficiation, as well as a set of actions to be taken to implement the policy, including the role of businesses. The framework in the Beneficiation Policy identified the enabling structures required to effectively implement the mineral beneficiation initiative. Working groups, teams and other supporting structures were formed, providing an implementation process for the policy document. This included a review of the instruments already available to the government and the demarcation of actions to be taken by businesses.[24]

[24] See the full policy document for details

Table 5 South African mineral beneficiation policy

Identified constraints	
• Inadequate skills • Limited exposure to R&D	• Limited access to raw materials for local beneficiation • Shortages of critical infrastructure • Limited access to international markets
Enabling factors	

• Multi-stakeholder structures for opportunities in value-addition projects
• Consultations and coordination of established structures to achieve beneficiation objectives
• International trade agreement assessments for opportunities
• Identification of strategic interventions for the government to undertake
• Policy and regulatory framework review:
  • Mineral policy
  • Mining charter
  • Income tax act
  • Manufacturing investment programmes
  • Industrial funding
  • Role of state-owned mining company	

Source: A Beneficiation Strategy for the Minerals Industry of South Africa (2011) Department Minerals Resource Republic of South Africa

4.2 Investment policy

From an investment policy perspective, supply-side CRM policies are seeking foreign investors as their domestic markets have limited capacity to take on technologically advanced green products. For simplicity, the investment policy discussion here assumes a focus on attracting international investors, acknowledging that domestic investors are also likely to be present.

A good investment policy addresses investment promotion, entry, incentives, protection, retention and grievance management (World Bank, n.d). For the promotion of linkages, the World Bank guidance advises on implementing policies that have assessed the scope and size of the opportunity, drawing together a list of high potential domestic firms to partner with, provide capacity building for the institutions that will embed linkages in their policies and implement a supplier development programme.

A review of supply-driven CRM policies notes that many of these investment policy support structures are ignored. The focus is largely on providing fiscal incentives, such as lower corporate income tax rates, reduced import duties, allowance for capital deductions and R&D allowances. The non-fiscal incentives include the establishment of a one-stop shop, competitive utility tariffs and facilitated provision of visas for non-resident foreign investors.

Supply-driven CRM investment policies often fail to take into consideration the steps after investment promotion and incentives. They provide little guidance on protecting and retaining an in-bound investment. The also ignore the sizing of the domestic capacity. Supplier development programmes, training and capacity building for domestic institutions to engage with the foreign investors as well as determining the suitable scope and size of the value-added activity (establishing technical parameters) are notable in their absence in supply-side CRM investment policies.

For GVC participation, countries tend to rely on designating SEZs to attract investors and local content policies to encourage investors to establish linkages.

Special economic zones

Many LMICs have SEZ programmes, also referred to as industrial parks. SEZs are considered a second-best policy for countries that are struggling with creating a wider business enabling environment due to lack of capacity and resources. SEZs can also be used as policy labs, allowing the government to test policies before they are applied nation-wide. However, in practice, most SEZs have struggled to deliver on their promised potential (Healy, 2018).

With CRM GVCs development, SEZs have attempted to cluster related activities with the objective of assembling near-by product producers (next link in the GVC and input suppliers) in the same geographical location. While a number of CRM related SEZs have been announced in recent years, the level of investment and manufacturing activity within these zones appears to be limited.

Utilising local content

Utilising local goods and services for manufacturing activity (the development of linkages) is a valid policy tool to ensure incoming FDI does not become an enclave sector and benefits spill over to the wider economy. Countries such as Australia, Canada and Chile have used incentive-based policies and a supportive business environment to establish competitive domestic suppliers and create both forward and backward linkages in their economies. Others, such as Ghana, Tanzania and Zambia have used mandated local content policies to achieve linkages in their mineral related sectors (Korink and De Sa, 2023).

Korink and De Sa's (2023) assessment of six case studies indicates limited success where local content policies have been used for creation of linkages from the mining sector. On forward linkages, prescriptive beneficiation requirements have often failed as domestic firms do not have the enabling environment or the competencies to produce goods with sufficient quality and at a cost that can be competitive in international markets (Yan, 2024).

The fatal flaw in most local content policy implementation is the assumption that a large inward FDI, in the mineral sector, will be sufficient to develop the domestic linkages being targeted by the investment policy. It fails to take into consideration the wider business environment in the country. With limited domestic firm capacity and enabling factors, these linkages fail to be established. Policy makers focus on local content requirements and pay inadequate attention to creating and strengthening domestic firm capacity and enabling factors.

For companies, fiscal incentives are just one factor to be taken into consideration in its investment decision. The inefficacy of enabling factors and competent domestic firms will not compensate for fiscal incentives for a company. For example, Mongolia's copper value-addition strategy lacked any domestic firm capacity building. In the case of Zimbabwe, it was the China-effect (related to strategic interests) and not the fiscal incentives offered that led to investments.

Indonesia, nickel & industrial parks

Indonesia's investment policy sought to develop Integrated Industrial Parks, close to mineral extraction locations, for smelting and other value-added activities. Fiscal incentives for investors included 100% tax holidays for up to 20 years, Value Added Tax exemptions on imported capital goods and those procured from its SEZs. To secure raw material inputs for these industrial parks, Indonesia extensively used ore and concentrates export prohibitions.[25] The trade policy, in this case, was used to support the achievement of the investment policy objectives.

In the case of nickel, this policy mix has produced some successes. In 2014, two nickel smelters were operational in the country. By 2021, this number had increased to 29 (Guberman et al.; 2024), with additional nickel based intermediate product (including EV batteries) projects being announced since 2021.[26,27]

The Indonesia Morowali Industrial Park is one of the largest Chinese investments in the country, focused on the nickel GVC, including the expected production of EV batteries. The park has received substantial financial support from the China-ASEAN Investment Cooperation Fund (under the BRI), the Export-Import Bank of China and HSBC China.[28]

The success for Indonesia in the nickel GVCs can be attributed to three factors: 1) its position as a major nickel mining country in close geographical proximity to its main market (China); 2) Chinese backed investments took place in GVCs as well as enabling activities such as energy generation; and 3) as an upper-middle income country and member of the G20, the Indonesian industrial complex reflected domestic firm capacity to meet the demand generated by foreign investors. Such a business environment was a positive consideration for companies making investment location decisions.

[25] Between 2009 and 2019, the government's off-again, on-again approach on ores and concentrate prohibitions caused a number of disputes, including a filing for consultation by the EU, at the WTO, on the export prohibitions on raw materials (WTO, n.d).

[26] See page 22 in Export Restriction on Minerals and Metals: Indonesia's Export Ban of Nickel (2024) for more details.

[27] See 'Critical Minerals Value-Added Policies: Indonesia's Story (2024)' for a more detailed presentation of the value-added activity in the nickel chain.

[28] See How Indonesia Unser Chinese Industrial Investments to Turn Nickel into the New Gold (2023) for a detailed discussion on how Chinese capital displaced European capital in Indonesia's nickel sector.

The success of the nickel GVC cannot be attributed to the nickel ore export prohibition alone. Indonesia attempted similar export bans for bauxite and copper ore. Bauxite ore production decreased by 95% after the 2012 export prohibition was announced. Chinese operators sought new sources for bauxite, shifting to other countries such as Guinea. The government relaxed its export prohibition in 2017. However, the decline in bauxite mining was so large by this time that Indonesia had lost its previous position as a top bauxite exporter. It has since failed to regain this position (Baskaran, 2024).

When the 2012 export prohibition on copper ore exports was announced, the two largest (non Chinese) mining companies entered into legal disputes with the government. Newmont choose to divest its investments in the country, while Freeport-McMoRan eventually acquiesced to the government's demand and invested in a copper smelter in 2024 (Baskaran, 2024).

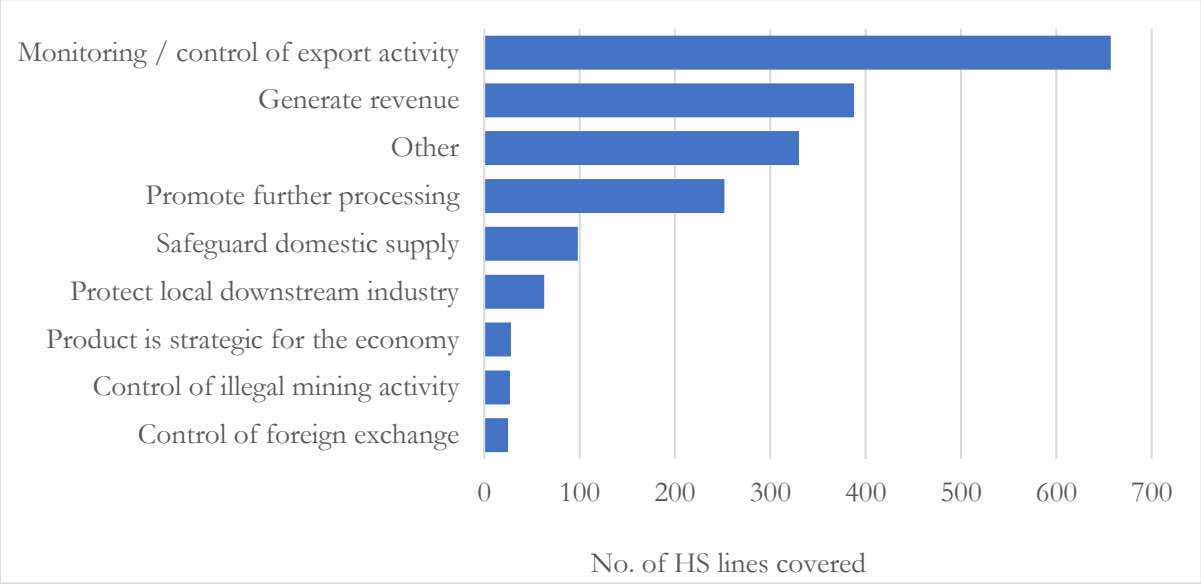
4.3 Trade policy

Trade policies reflect a government's efforts to manage its economic relations with other countries and regions. For supply-side CRM policies trade policy tools are a natural ally, as they are the most direct way to control CRM ores and processed material flows. The four main tools available under a trade policy are tariffs, quotas, export restraints and subsidies, which can be used to manage imports and exports.[29] World Trade Organisation (WTO) Article XI (1994), requires governments to act towards the elimination of all tools that can act as quantitative restrictions on exports (such as quotas, import or export licences or other measures). However, the use of export restraints for mineral exports is noted for several LMICs.

For trade policy restrictions involving CRMs, the OECD (2024) notes increasing incidents of export prohibitions over the past few years. Kowalski & Legendre's (2023) assessment of CRM trade restrictions concludes: "Overall, the research so far suggests that export restrictions may be playing a non-trivial role in international markets for critical raw materials, affecting availability and prices of these materials."

An OECD (2024) review of government objectives for using restrictive trade policy (for all materials) notes that the most common objective stated is for the monitoring of export activity and revenue generation (Figure 6). Promoting further processing and safeguarding domestic industry are also noted.

Figure 6 Incidents of use by HS lines, of restrictive tools by purpose (2022)



Source: OECD Database on Export Restrictions on Raw Materials (2024 <accessed 12.10.2024>

[29] See Annex 1 for a detailed explanation of these tools.

Table 6 lists commonly used trade restrictions by countries which are a major source of mined cobalt, copper, nickel, lithium, manganese and PGMs. The objectives of these tools can range from monitoring trade flows to fostering value-added activity.[30]

Table 6 Use of trade tools by number of HS lines targeted by country (2022)

Country	Trade restriction	No. of items	Trade restriction	No. of items
Low Income				
DRC	Export surtax	64	Licensing requirement	68
	Export tax	66	Other export measures	64
	Fiscal tax on exports	64		
Madagascar	Export prohibition	1	Other export measures	41
	Licensing requirement	29		
Lower middle income				
Philippines	Fiscal tax on exports	3	Export prohibition	1
	Licensing requirement	3		
Bolivia	Export tax	13	Licensing requirement	20
	Fiscal tax on exports	33		
Upper middle income				
Argentina	Export prohibition	1	Licensing requirement	24
	Export tax	73	Other export measures	2
South Africa	Export prohibition	1	Licensing requirement	45
	Export tax	1		

Source: OECD Database on Export Restrictions on Raw Materials (2024 <accessed 12.10.2024>

For example, DRC uses multiple trade restrictions, including licensing requirements for mining companies to create domestic value-added activities. However, monitoring illegal mining activity – to prevent smuggling, particularly where artisanal and small-scale miners are active in the region – is also achieved through licencing requirements. To aid government revenues, it imposes multiple taxes on exports. At the same time, these taxes make it more cost efficient for mining companies to process ores and concentrates within the country. Two goals are achieved with the same trade policy tool.

Madagascar is a major producer of nickel and graphite and hosts one of the largest global nickel projects in the world (Ambatovy project), which refines cobalt and nickel in country. As noted in the table above, Madagascar has a fairly light touch to trade restrictions, with licensing requirements (for monitoring purposes) and other export measures. The Mining Code (2023) does allow the government discretion to establish quotas for domestic market diversion of output, this option has not been used to this date. The country has chosen fiscal and industrial policy to encourage value-added activities. For example, a reduction in the royalty rate on mined products is offered if the minerals are processed in-country, but no restrictions are imposed on ore exports. Apart from the cobalt and nickel refinery mentioned, there appear to be few value-added investments in the country. In 2024, NextSource Materials which operates one of the largest graphite mine in Madagascar, selected Mauritius as the location for its Battery Anode Facility, exporting graphite flakes from Madagascar to Mauritius. The decision to locate in Mauritius, which has no mineral assets of its own, was based on the more favourable operational, financial and logistics benefits offered by the country.[31]

[30] In contrast to the previous two subsections, limited literature availability did not allow for an extensive case study where a trade policy instrument is (effectively) used as the main tool for CRM processing and value addition. However, short country examples are included here to provide additional insights into the use and effect of trade policy instruments involving CRMs.

31 See 'Madagascar: NextSource Materials picks Mauritius to house its first EV battery anode plant in Africa' (April, 2024) for details.

Both the Philippines (nickel ore exporter) and Bolivia (lithium salt exporter) are seeking to increase the number of refining plants in their domestic markets. For now, the level of trade restrictions used by the Philippines are minimal to target value-added activity in the country.[32] Bolivia, however, used export taxation, licensing requirements as well as additional fiscal taxation of exports (a product is only taxed when it is exported and not when supplied to the domestic market). The Bolivian export restrictions are in line with the strategy of its state-owned lithium company (Yacimientos de Litio Bolivianos). Since 2017, the company has been given control over the entire lithium supply chain in the country. Private investments in the lithium sector are negligible. In 2023 the first industrial scale processing plant became operational, which was construed by a Chinese firm. Further investment agreements for lithium beneficiation and value-added activity are under negotiations with Russian and Chinese consortiums. This state dominated strategy for value-addition has produced investment results. It has also raised issues around transparency and corruption involved in the negotiated deals, as well as concerns around the socio-environmental impacts of lithium extraction and processing.

South Africa, with relatively advanced industrial capabilities, makes extensive use of licensing requirements to monitor trade flows to assist in shaping its value-addition policy. The licensing acts as a data source to determine competitive advantage and use industrial and trade policy to promote products; for example, its targeting of PGMs and autocatalytic convertors. Argentina, the world's third largest lithium exporter, similarly does not use export restrictions, instead relying on its Large Investments Incentives Regime to attract large-scale FDI. Licensing requirements are used for monitoring, rather than trade restriction purposes. The country has maintained a 'pro-market' approach, with successive governments supporting industry with incentives and favourable regulatory frameworks since the 1990s, which attracted investors to the country. Lithium was never declared as a 'strategic mineral resource' and market interventions by the state (such as trade restrictions on exports) were not introduced. Where a tax on mining exports was introduced, it was counterbalanced by allowances in corporate income tax rates.

A company's risk assessment of a trade policy is influenced by several considerations and varies by value chain stage. For a mining company, with a non-movable asset, the biggest risk is related to being unable to ship out its ore and concentrate output. Depending on the quality of the mineral body (and its profitability), government requirements for investing in smelting and refining will be considered as a cost of doing business, if the commercial viability of the mineral asset is assured. For example, the Zambian processing trade restrictions on chromium ore and ferrochrome are seen as a cost of doing business for Chinese ferrochrome smelting companies.

For companies considering investments in intermediate and final products, which are movable investments, risks associated with trade restrictions are greater. Particularly, where these products are part of a locked value chain – lead firm exerts control over the value chain – cross-border movement of inputs and outputs is an essential part of doing business. Value-added investments tend to have limited geographical captivity, in relation to geological assets. Investment considerations will be negatively impacted unless the trade restrictions are seen as a cost of doing business.

The cost of doing business can also emerge from demand-driven CRM policies. For example, MoUs being agreed by the USA and EU with the DRC are aimed to achieve cobalt supply diversification away from Chinese producers. Agreements to invest in value-added projects are largely seen as the cost of doing business (accessing cobalt and copper mineral deposits).

The OECD database indicates that middle-income countries use export prohibitions on raw materials and intermediate products to protect their domestic (established) downstream industry. For example, Malaysia and India use export prohibitions for raw materials to protect their steel industry. In contrast, middle and upper-middle income are more likely to use export taxation as the major tool to influence mineral and intermediate product flows. Such policies are perceived more positively by companies, as they assist in their cost competitiveness rather than force a value-added activity that would otherwise not be commercially viable.

[32] In 2024, there have been indications by the Philippines government that it is considering introducing trade prohibitions on nickel and copper ores to increase value-added activity in the country.

4.4 The inefficacy of extending mineral policy to value-addition policy

To manage investments in the mining sector, governments tend to use natural resource specific regimes, from royalty rates to export taxation. Such a mineral regime usually differs from the regime applicable to other sectors in the economy (Kowalski & Legendre; 2023). The environmental code, mining licencing, local content requirements, state equity share etc. also tend to be different from other industrial sectors.

Attracting investors under a mining policy is not a challenge where a country has viable mineral resource assets. As the operational location of a mining company is largely determined by the richness of geological reserves, they acquiesce to operate under stand-alone mineral regimes if the mining code is relatively stable, and its risks can be managed.

When it comes to mineral value-added activities, governments take a similar approach to their treatment of the mining sector; assuming that the quality of their mineral assets will be sufficient to bring investments into value-addition activities. A restrictive export policy, where access to the raw material is hindered, is therefore assumed to be sufficient to produce the intended results. The enabling environment as well as industrial and investment incentives are often ignored.

This is flawed logic as the regime approach from the mining sector does not transfer over to a value-added sector. For example, a mining operation is long-term in nature and, from exploration to operation, can take 20 years with a similarly extensive life-of-mine. A mining company will largely raise capital from international investors. Unless mandated, it will not draw energy from the national grid but have its own energy generation units on site. Where it is unable to use existing infrastructure, it will construct its required transport corridors through public-private partnerships. Customs administration can be a challenge, but it will work towards ensuring minimal delays to its shipments. Access to the mineral asset is a necessary requirement for investment.

In value-added operations (smelting and refining, intermediate and final products) companies are not geographically limited and will invest in countries best suited to their operational needs. Value-addition operations can have comparatively shorter life spans. For instance, in the face of adverse market conditions they can be temporarily shuttered or completely disinvested in the medium-term. Capital raising is often done at both domestic and international stock exchanges. These firms do not invest in infrastructure and are unlikely to establish their own energy sources. Additionally, these operations are energy and water intensive and rely on the national grid for utilities. Imports and access to technological needs and equipment will have greater variability than the mining sector (particularly for some CRM value-added products such as EVs). Access to a nearby mineral asset is an advantage, but not a sufficient requirement for investment by the company.

Therefore, from a company's perspective while a mineral policy may be acceptable for an investment, extending the same principles to value-added investments is not.

A balanced policy mix is essential

The final question this report sought to address was: how effective are supply-driven CRM policy initiatives in achieving sustainable value-addition investments? To answer the question, we need to consider the underlying approach governments have taken towards mineral related value-added activity. Where value-added policy is considered an extension of a mining policy, success has been very limited. Where an industrial policy approach has been taken, more success is noted.

For effective value-addition policies, the policy mix needs to balance all three aspects from industrial, investment and trade policies. Depending on the market impediments some policy tools may be used more than others, but reliance on a single policy (such as trade) will not provide effective results.

Additionally, value-added success is noted for countries that have divorced their mining sector policy approach from their value-added policy approach. South Africa used an industrial policy with investment incentives to develop an autocatalytic convertor sector from its PGMs. Indonesia's industrial parks approach was divorced from its mining policy approach, i.e., trade restrictions alone did not deliver results, attention was also given to establishing energy plants and industrial clusters in these economic zones. Investment incentives in the form of tax breaks were also offered.

To be cost competitive, economies of scale, industrial clustering and access to affordable energy matter for companies. Geographical proximity to input providers (chemical reagents, crushing and filtering machinery providers etc.) and to customers (intermediate product manufacturers), reduces transport and coordination costs for a processing unit. These variables fall under an industrial and investment policy remit.

For refined CRMs, this cost competitiveness will be also measured against Chinese producers in international markets. China's strategic policy efforts over the past decade for CRM processing have enabled the country to hold an estimated 80% of global processing capacity (Manning, 2024). For REEs it accounts for 90% of capacity, 78% of refined cobalt production and 50% of global smelter production (ICSG, 2024).

It would be a miss to view China's dominance in processing and refining capacity without acknowledging the supporting infrastructures and policies that helped achieve this dominance. Enabling factors, such as the creation of industrial clusters, suppliers of inputs and energy availability have led to this dominance.

Summary

Building on the GVC framework outlined in Chapter 3, companies that are being asked to join, expand or specialise their operations within a GVC in a country will consider the impact of the policy mix (industrial, investment and trade) to make investment decisions. Supply-side driven CRM policies have focused on making access to CRM geological assets a necessary condition for value-added investments. However, it is not a sufficient condition for a firm to finalise an investment decision.

The review of industrial policy indicates that the presence of enabling factors and domestic firm capabilities is a principal consideration for an investing firm. Incentives from both demand and supply-driven CRM policies are rarely considered significant enough by an international company to overcome domestic limitations – unless there are strategic interests that override them.

The review of investment policy made a similar argument. Fiscal and non-fiscal incentives, while relevant, will not result in value-addition FDI where enabling factors and domestic competencies are low. Considerations above the commercial viability of a project are only made when there is a strategic advantage to be gained by the investment opportunity for the company (and its home country).

The tools used under trade policy can have multiple objectives for the government, including supporting domestic value-addition. For a mining company, trade restrictions are only acceptable as a cost of doing business, when accessing the CRM ore asset is a commercially profitable goal. For value-added activities trade restrictions are seen as high risk, particularly where GVCs require ease of movement of inputs and outputs across borders.

In the examples listed in this report, the only factor that overrides the policy risks for companies, is where strategic factors outweigh the commercial factors. The cases for Zambia and Ghana indicate that the strategic need was a greater consideration than commercial profitability alone. This is a risky approach to value-addition policy by a government – when the strategic need fades, projects are likely to be shuttered or abandoned.[33]

Therefore, regardless of joining, fixing or specialising participation within GVCs, an investing firm will judge the effectiveness of the policy mix, based on the impact on its commercial viability. This is largely dependent on the operating capacity of the country. Where the policy mix is heavily dependent on trade tools and ignores domestic firm and industry frameworks, a dearth of investment projects has been noted.

[33] For example, at the end of the previous commodity price boom (2009), several copper projects were simply abandoned by their Chinese owners in the DRC and Zambia, as the fall in copper prices no longer qualified these as strategic investments.

5. Implications for shaping policy interventions

Chapter 1 noted that the space for policy intervention has been created in the recent price boom for CRMs due to the specific characteristics of this sub-group of minerals, the attraction of accessing high-income export markets that are not dependent on trade concessions, and the political shift towards resource nationalism in CRM ore rich LMICs.

Chapter 2 addressed how the growth framework, which uses both the concepts of GVC and linkages, informs the foundation of supply-driven CRM policies. Chapter 3 used country case studies to show how investment, trade and investment policies and strategies have been deployed for market joining, fixing and specialisation). Dependent on the mixture of industrial, investment and trade policy tools used, some successes were noted.

In this chapter, the report steps back from policy tools and GVC participation discussions and shifts focus to the shape of a policy intervention. This is offered as a theoretical discussion, based on the evidence in the case studies, as fully developed CRM value-added investment projects remain few and far between at this time. There are very few examples of operating projects on which to base a more data-driven analysis.

The purpose of the theoretical framework is to understand how policy interventions can be shaped to support CRM value-added activity. The framework is underpinned by two material factors: 1) the value attributable to mineral content, and 2) geology induced geographical captivity.

Product value attributable to mineral content

As a mineral value chain progresses from extraction further downstream, the contribution of the mineral content to the value of the product decreases. This is indicated by the share of the cost of the mineral in the product. At the extraction stage, the value of the ore and concentrate is reflective of its mineral content or purity. As the product moves downstream, a larger contribution to value originates from the design, chemical, industrial, technological and assembly processes it undergoes, i.e., the value attributable to mineral content lessens.[34]

Implication for shaping policy: a policy will be most effective when it is influencing the factor that creates value within a product. Thus, at the upstream stage where the mineral content attributes greater value to a product, policies targeting mineral access will be effective. At the downstream stage where greater value is attributable to non-mineral factors, policies targeting these factors, such as improving cost competitiveness, will be more effective.

Geology induced geographical captivity

As a mineral value chain progresses further downstream, the geology induced geographical captivity of the products starts to decrease. At the extraction stage the product is completely geographically captive; a mine will be located where there are viable geological reserves. Geographical captivity starts to lessen at the smelting and refining operations stage, dependent on the mineral, associated transport costs and refining technology. CRMs can be refined near the mine-site (cobalt from copper ores) or in a different country (REEs from Malawi will be refined in Poland). Intermediate products are more mobile investments, with fading geology induced geographical captivity. By the final product stage, geology induced geographical captivity is non-existent. Other factors, such as being closer to next-in-line firms in the GVCs and consumers, becomes a greater determinant of the location of operations.

Implication for shaping policy: policies dependent on geology induced geographical captivity will be the most effective where the product is strongly captive. Where the captivity is weak, policies based on geographical limitations will be ineffective. Thus, policies targeting domestic value-addition will be more successful in the upstream nodes of a GVC (where geographical captivity exists). At the downstream segments, where geographical captivity is weak, policies that are targeting enabling factors will be more effective. This includes increasing cost competitiveness by addressing transport costs, access to technology, skilled labour, capital markets and so forth. Some LMICs have tried to artificially create geographical captivity in downstream segments, by trying to extend the raw material captivity element to other parts of the value chain. For example, when access to ores is only allowed when a value-added investment is made. Given the scarcity of CRM ore assets available in the present, such a policy may force some value-added investments

[34] Does not include precious metals (such as gold) or precious stones (such as diamonds), where the value of the final product is largely dependent on the value of the mineral.

to take place. However, in the long run, such captivity will be easily lost as new sources of CRM ore assets emerge.

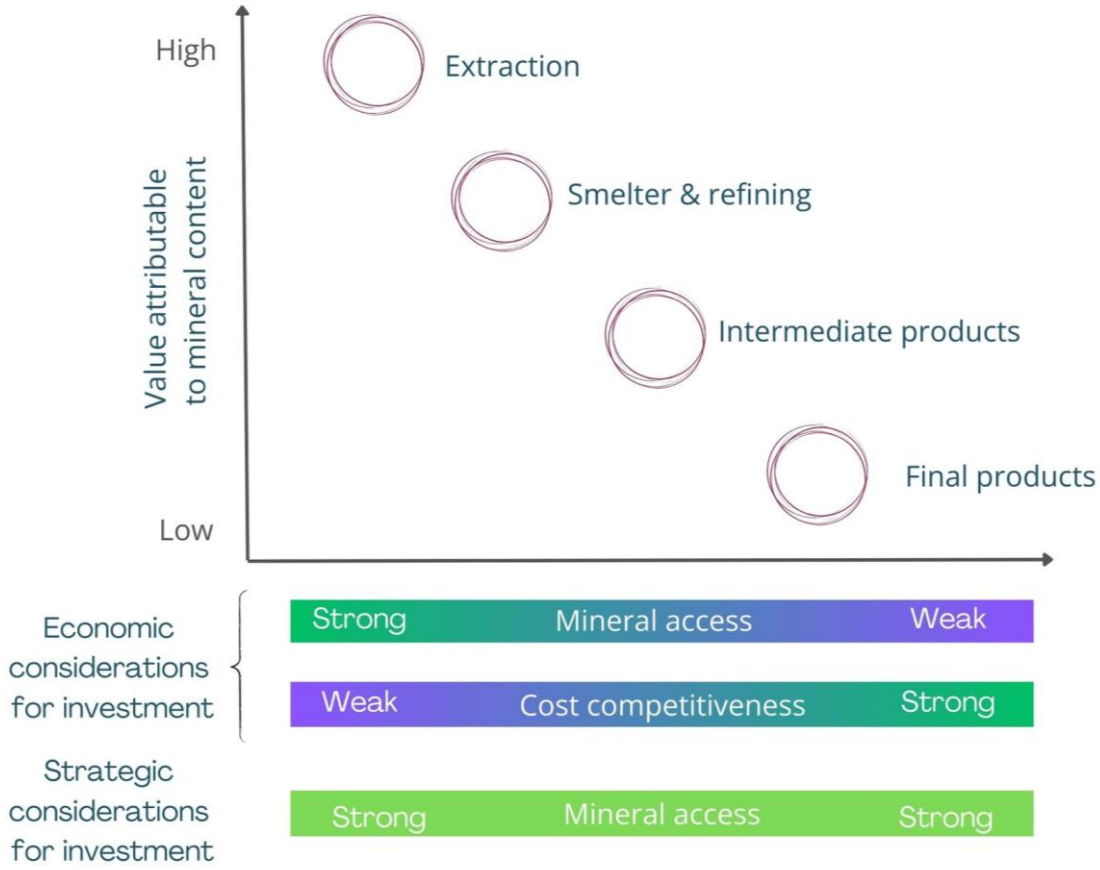
5.1 Effectively targeting policy within a GVC

The implications for shaping an effective policy mix based on mineral content and geographical captivity are illustrated in Figure 7. In this simplified version, the vertical axis indicates the contribution of mineral content to the value of a product, which is the highest at the extraction stage and decreases as the GVC moves to the final product.

The horizontal axis represents the economic considerations for investment along the GVC. The first consideration (mineral access) reflects geology induced geographical captivity and is the strongest at the upstream (extraction) stage, weakening as the GVC progresses downstream. The second economic consideration is cost competitiveness, which is the weakest at the extraction stage, progressively becoming stronger as the GVC moves downstream. This is not to suggest cost considerations do not exist at the extraction stage, but they become more relevant at later stages of a GVC.

One final point is made under Figure 7, where strategic considerations are paramount for an investment, mineral access will remain a strong consideration over the entire GVC. In these cases, mineral access overrides cost competitiveness in the decision making of the investors. The decision where to locate the GVC nodes, smelter and refining, intermediate and final products will take place not where it is most economic to produce them but where access to minerals (extraction) is crucial for all other nodes.

Figure 7 Mineral content & value-addition considerations



Source: Authors compilation

This framework helps in understanding the appropriate policy targeting within a CRM related GVC. Policies that use mineral access as a leverage to induce value-added investments will largely be effective at the upstream stages (extraction, smelting and refining) of a GVC. Policies that target improved cost

competitiveness to induce value-added investments, will largely be effective at the downstream stages (intermediate and final products) of a GVC.

Policies that aim to leverage mineral access to target downstream activity will be ineffective – as noted in the case of Mongolia (copper) and Zimbabwe's 2011 ores and concentrates prohibition. South Africa's targeting of cost competitiveness factors for PGM autocatalytic convertors, and the resultant success, was an example of the correct policy targeting the appropriate segment of the GVC. In the Zimbabwe (2021) export prohibitions, value-added investments resulted from China's strategic interest, overriding the economic considerations for investments.

Effective policy mix for market joining

As noted in Chapter 3, market joining focuses on creating domestic capacity where none exists. The objective for LMICs should be to establish the first industrial unit. Dependent on which segment of the GVC this first-mover is expected to invest in, an appropriate policy mix will need to be constituted.

- Smelting and refining: given the relative strength of mineral content and geographical captivity, policies targeting mineral access would be the most relevant.
- Intermediate product: given the decrease in both mineral content and geographical captivity, policies targeting cost competitiveness factors would be the most relevant.
- Final products: given the near absence of mineral content and geology dependent geographical captivity, effective policies will target firm establishment and performance as well as sector framework improvements, i.e., cost competitiveness.

Effective policy mix for market fixing

As noted in Chapter 3, market limitations hinder the expansion of an existing value-added activity. The KPI for the government is to facilitate economies of scale and further investments. As with the previous category, dependent on the GVC stage being targeted, the appropriate policy focus will vary from mineral access to improved cost competitiveness.

The difference from market joining, however, is that the first movers have already been established. The policy intervention required is to address the specific challenges being faced by these operating firms. If mineral access is not identified as a challenge, the policy should not focus on diverting domestic mineral production to the sector. If accessibility and cost of utilities is a challenge, the policy should focus on strengthening framework conditions. Where capital raising limitations are an issue, the policy mix should look at capitalising on international mineral agreements and partnerships to bring in more blended finance.

Effective policy mix for market specialisation

Market expansion, within the CRM context, was noted as a strategic-project orientated approach. The policy mix steps away from wider national level policies and focuses on a single project. The effective policy mix will be driven by the technical requirements of the project and can range from import duty exemptions to paid state-equity participation. Given the amount of flexibility in this approach (as it is project specific) any GVC stage can be targeted. However, it would be the most suitable for the downstream segment, as these capital, technology and skills intensive investments are the most difficult to attract for LMICs.

5.2 Choosing between industrial, investment & trade policy tools

The discussion of policy tools in Chapter 4 indicates multiple tools from industrial, investment and trade policies can be used to achieve the objectives listed above, however trade policy tools have been most commonly observed within the supply-side CRM landscape.

Based on interviews, the reasons for favouring trade policy (export prohibitions and taxes) are attributed to government capacity constraints. Trade policy levers make negligible use of limited government resources and are easy to implement. Industrial and investment policies require more effort at generating consensus between various government ministries, coordination across government agencies and institutions, or utilisation of finances within national budgets to build domestic capacity. The incentives provided under an investment policy can also have impacts on other (non-CRM) operations and sectors. For example, tax breaks offered to one group may encourage other industrial groups to demand the same recompense. Industrial and investment policy is more complex to draft and implement. Additionally, resource nationalism-based messaging by the government is seen to incur favour with the voting public, yet the failure to deliver value-added investments attributed to 'others' and not the government.

For value-added investments, industrial policy remains central. Under the two (supply-side) vectors of industrial policy that focus on firm competitiveness and industry competitiveness (see Figure 5 Supply-side industrial policy instruments) it needs to address both firm performance and the industry framework. Investment and trade policy are meant to support the industrial policy and not take its place.

From a policy effectiveness standpoint, as noted in Figure 4, a company will respond to both demand and supply-driven CRM policies in narrowing down the jurisdiction in which to invest. Demand-driven CRM policies are following a 'anywhere but China' approach, leaving a number of possible jurisdictions for companies to invest in. For the company, the cost competitiveness factor (enabling environment, country risk profile etc.) are the relevant considerations for an investment decision.

For supply-driven CRM policies, host governments which have attended to these cost competitiveness factors, greater success in attracting value-added investments is noted (South Africa, Indonesia). Where these policies, to compensate for limited government capacity, have taken a project approach (Ghana), again success is noted. Policies that have ignored the domestic capabilities issues (such as Mongolia), have not seen successes. Even the case of DRC, where substantial investment commitments have been announced under the Minerals Security Partnership, the literature review has not indicated progress on the establishment of value-added activity; the investments being actioned mostly relate to infrastructure corridors and communication projects.

Trade policy as a second-best tool

Market joining, fixing and specialisation are dependent on the domestic capacity of the economy to support such value-added functions. Trade and investment policies are meant to support the industrial policy in creating an enabling environment for firms to become competitive. The scope of this report focused on identifying LMICs with CRM ore assets, successfully developing value-addition projects and investments using trade policy as a main pillar. In the case studies reviewed in this report, three assessments can be made for the use of trade policy.

First, where used as the leading policy for creating value-added investments, it has largely failed to achieve the desired results. As a leading policy it is only the second-best tool to address the market failure, i.e., the inability to create interest from domestic or international companies to invest.

Second, Second, trade policy can achieve (limited) success, where strategic interests outweigh other investment considerations. For example, in case of Zimbabwe's use of trade restrictions (on chromium ore) was successful in creating value-added investments (smelters), as it leveraged the strategic interest of the Chinese operators seeking to access high-grade chromium mineral assets.

Third, trade policy when it is located within industrial policy, has the highest probability of success. The case of South Africa and PGM auto-catalyst convertors illustrated the use of trade policy as part of a wider policy framework, with the improvement of firm competitiveness at its core. Indonesia's nickel related industrial development parks show a similar finding. Although China's strategic interests also played a part here, the success of the park (market joining, fixing and specialisation occurred), the combination of investment policy, existing industrial capacity and trade restrictions all contributed to the achievement of the government's objectives.

One, however rather simplistic, conclusion is that trade policy needs to be contextualised within the domestic industrial capacity of a country. Where there are significant strategic interests by the investors, trade policy can be adapted to help deliver CRM related value-added investments LMICs.

Summary

Policy targeting within a GVC is most effective when it addresses the factors that create value within a product. Where this value comes from mineral content, mineral access policies will be effective. Where the value is generated from non-mineral factors, policies addressing the firm's cost competitiveness and industry framework will be more effective.

With the policy mix (industrial, investment and trade), various tools can be deployed to meet the same objective – fiscal incentives/restrictions and ore export prohibitions will achieve the same result – divert raw material flows to the domestic markets. The more effective policy tool should be viewed from the investing company's standpoint. Where policies support a company in meeting its investment objective,

they are likely to be more effective. Where a company can choose to relocate to a more favourable investment environment, CRM value-added investments will fail to materialise.

6. Role of international partners

The international messaging on CRM related value-addition opportunities has been, by now, clearly established. There are multiple origins of this message: government statements (both in the North and South); international development institutions (World Bank, Regional Development Banks); think-tanks and consulting firms; and actors from the RE and EV industries. Policies and strategic partnerships have been announced and financing commitments made.

The next step, however, is lacking both in terms of frameworks and structuring. The absence of details on 'how' these value-addition opportunities can be realised through industrial policies, supported by investment and trade policies, is noticeable in the literature reviewed. Successful value-addition cases are attributable, in part, to China's strategic interests rather than the efficacy of the policy itself.

For the policy mix to be effective, government considerations need to be cognisant of the company's viewpoint. This is equally applicable to firms in the Global North and South, including Chinese operators. The conditions under which a company will make an investment will be based on economic factors and the strategic concerns of its home government.

To construct such a policy mix, international partners have a role to play in assisting LMIC governments. The following are recommendations for enabling the next step, in moving from policy announcements to effective and implementable plans.

6.1 Addressing knowledge asymmetry

Technical knowledge of CRM value-added products

CRM based products are high capital, skills intensive and advanced technology products. In interviews, it was reported that most low-income government officials do not have the technical understanding of what is entailed in the manufacturing of these CRM related intermediate and final products. This includes information on the scale of capital required and the companies who can avail such finance under international partnerships; the level and types of employment generated (including in linked industrial activity); the conditionalities of importing countries (including tariff and non-tariff barriers); lead firm sustainability certification requirements; and restrictions on technology and equipment by exporting countries. In addition, certain technologies are still in flux and may change considerably over the next five years, such as EV batteries shifting from lithium-ion to sodium-ion batteries. Without a technical understanding of what CRM based value-added products entail as well as the implication for benefits accruing to the national economy, government officials are limited in their capacity to make informed decisions on the pursuit of value-added investments.

Market information on CRM value-added products

The global markets for CRMs and their value-added products are also changing. For CRMs, market forecasts (such as from Benchmark Minerals Intelligence, CRU, Wood Mackenzie), are warning of over-supply and price slumps for REEs, cobalt and lithium in the years ahead. Where access to supply is currently a concern, the products that use these minerals could also be facing downturns in the medium term. For example, while EV car sales account for 18% of total car sales in 2023 (up from the previous year), these sales are also under pressure. Recent company disclosures from the top EV manufacturers all note shrinking sales forecasts. Without information on the expected market conditions for CRM ores and concentrates and their value-added products, government officials do not have all the information required to make an informed decision on CRM policies. The headline figures in political statements and mainstream media highlighting the demand for these products over the past five years, are not covering the same information that companies are using to make their investment decisions.

Support from international partners: for better informed decision making, LMIC government officials can benefit from technical and market outlook information. This is usually provided by private sector actors, with expensive price tags. Providing access to similar information that companies are using to make investment decisions can close the knowledge asymmetry that exists between investors and policy drafters. In addition, such information can also combat some of the political messaging rhetoric emerging from various sources.

Assisting governments in drafting pre-feasibility level studies for investment projects can also help officials in recognising what such CRM investments will deliver for the country (in terms of employment and revenue generation) as well as in having more particularised negotiations with potential partners for such investments.

6.2 Policy targeting & effectiveness

Appropriate policy context considerations

Benefitting from CRM ore assets is an understandable objective for LMIC governments. But it is how these policies are executed that is limiting (or even negating) the achievement of this objective. The research for this report indicates incorrect policy targeting by GVC stage. In addition, there is heavy reliance on trade policy to create value-addition, while there is limited use of industrial and investment policy. This imbalance in policy mix impacts the effectiveness of the government's objective to create value-added opportunities.

CRM policies cannot be divorced from wider socioeconomic and environmental policies. As noted, energy and water resource stress are an issue which CRM policies seem to make scant reference to. A review of domestic capacity of other industrial sectors that can be upskilled to generate the linkages from GVCs is also not noted.

Policies that address issues such as skills development, R&D, infrastructure and e-commerce that are required to support CRM policies are either not considered or fail to be implemented. Socioeconomic impacts (CRM value-added products are not high employment generators) and the cost of environmental damage (refining and intermediate product manufacturing is related to chemical and emissions discharge) are rarely mentioned in supply-side CRM policies.

Supporting policy structures

The announcement of a policy needs to be accompanied by its framework structures, assigning ministry and agency responsibilities, issuing regulatory guidelines, allocating performance indicators and review procedures. The lack of supporting structures was noted for many of the CRM policies (particularly where SEZs were involved). CRM policies fail to deliver as their support mechanisms have not been designed or are unrealistic to be implemented.

Awareness of the opportunity cost

For informed decision making, government officials also need to be aware of the opportunity cost of their CRM policies. Focusing on the potential value generated by value-added activities alone can result in the failure to appreciate the loss in export and other revenues resulting from trade restrictions on ores and concentrates. For example, when the focus is on how much investment and employment can be generated by an industrial activity, the loss in mineral production volume and the resulting loss in government revenues is not being considered. Under a restrictive trade regime, the expansion of downstream activity is occurring at the cost of the upstream actors. The benefits are being transferred from one segment of the GVC to the other, whilst they may not be increasing as whole. In the review of CRM policies, where available, economic projections by governments are noted for potential revenue and employment from value-added investments. However, the research could not locate the calculations or acknowledgement of the opportunity cost of such policies by the same governments.

Another issue around opportunity costs considerations is that these costs may exist outside the CRM value chain. One issue brought up in the interviews for this research was the LMIC governments focus on CRM value chains, to the detriment of other sectors. For example, considerations for leveraging access to CRM ore assets to improve investments in agriculture, food, horticulture or other sectors are not being undertaken. These sectors can generate wider employment opportunities, utilising and improving existing capacities in the economy, which may lead to more sustainable growth. In addition, the government resources being used to pursue CRM value-added investments (time, human resources), are being done so at the expense of development in other sectors.

Support from international partners: in general, a silo approach to policy development and targeting is now being replaced by a nexus-approach by leading development institutions, such as the World Bank. Such an approach considers multiple sectors within the boundary of one policy design. Assistance in developing government capacity in constructing the required delivery mechanisms would help deliver policies that are well-drafted. In other cases, assistance in effective policy targeting, appropriate for a GVC segment (upstream and downstream) is required. In the author's opinion, the approach towards such support needs to be co-development driven – the government and its stakeholders are at the centre of the process, and policy and structure design ideas originate from them, rather than external consultants.

6.3 Capacity building on mineral partnerships

One final recommendation is based on interviews and discussions with government officials and industry stakeholders in low-income African countries. This relates to understanding what is on offer under the mineral partnerships and MoUs being signed with the EU or the USA by the LMICs. While the headlines on available assistance and finance are clear, how these partnerships will work in practice is not clear. Clarity is required on the criteria for accessing finance under these schemes; the rules governing the transfer and import of technology (which is often protected by intellectual property rights); and clarification on the type and levels of national employment opportunities that will be generated. Opacity on these issues is leading to concerns that the approaches are similar to previous 'mineral raids' by high-income groups, where minerals are extracted but little value-added activity created within the mining communities and countries.

Another consideration is building the capacity of government institutions engaging with firms that will be responsible for the value-added investments. Concerns around power asymmetry, i.e., that the firms wield more power due to their technical knowledge and financial capabilities than the host government during a negotiation process, were also verbalised.

*Support from international partners: c*apacity building and knowledge sharing on how to benefit from these mineral partnerships will aid governments, domestic investors and industry actors to better benefit from demand-side CRM policies. At the moment, their messaging is heavily focused on incentives being offered, which assumes that partners will know how to engage with these initiatives. For some LMICs this may be true. However, capacity building through technical training on developing feasibility studies and investment plans, detailed regional market outlook preparations and collaborations between industry actors within the African and Asia-Pacific region could provide much needed support for governments to prepare more effective supply-side CRM policies and benefit from the opportunities of mineral partnerships.

Summary

This chapter considers assistance from international partners in addressing the hurdles encountered when low and middle-income countries attempt to implement CRM value-addition policies – which suffer from a significant disconnect between the objectives of such policies and their effective implementation.

A key obstacle is the knowledge gap: governments often lack crucial information regarding CRM technologies, market trends and the specific investment requirements associated with these projects. This lack of knowledge severely hinders their ability to make informed decisions. Furthermore, existing policies frequently suffer from inadequacies such as misaligned policy targeting, an overly narrow use of trade policy and a neglect of crucial factors like environmental impacts and the potential opportunity costs associated with CRM value-addition policies.

To address these challenges, the recommendations include bridging the knowledge gap by providing governments with access to the technical and market data that informs industry decisions. Secondly, a more holistic approach to policy design is recommended, that considers the interconnectedness of various policy tools and that harnesses the opportunities embedded in demand-side CRM policies.

This report underscores the necessity for a more comprehensive and nuanced approach to CRM policies, one that prioritises informed decision making through knowledge sharing, effective policy design and a thorough understanding of the potential benefits and drawbacks of different policy options.

Annex 1: Trade policy tools

The review of supply-side CRM strategies noted extensive use of trade policies. This annex provides information on commonly used trade tools listed in Table 7.

Table 7 Tools used for export restrictions for minerals & intermediate products

Export restriction	Description
Export tax	Tax collected when a product leaves a customs territory. Category includes export tariffs, export duty, export levy and export charges.
Fiscal tax on exports	Tax not applied at the border but applied on goods intended for exports. The tax is not applicable when they are consumed in the domestic market. Includes sales tax on exported goods and export royalty.
Export surtax	A tax in addition to the export tax, usually under a progressive tax system. Includes export surcharges.
Export quota	A predetermined maximum volume permitted for exports.
Export prohibition	No exports permitted; includes exports bans and export embargos.
Licencing requirements	Prior approval required (as a licence), with additional documentation submitted to get approval. Also known as export permits.
Qualified exporters list	The right to export is allocated to specific companies. There is no limit on volume of their exports.
Domestic market obligations	A requirement to allocate a proportion of the firm's output to the domestic market.

Source: Methodological note to the Inventory of Export Restrictions on Industrial Raw Materials. OECD (2022)

3.1 Export prohibition

Analytical analysis: Export prohibitions are largely used in the upstream segment of the green technology value chain. Low-income countries, with limited to non-existent industrial/value-added activity but with CRM mineral assets, are most likely to use this approach. The government strategy envisages that mining companies and consumer governments will agree to the establishment of value-added activity in country to access supplies.

In lower-middle income countries, where some domestic smelting and refining capacity exists, the use of export prohibitions is noted to secure supply of raw materials to expand this segment of the value chain.

The mechanism functions by reducing the price of raw materials in the domestic economy. In the case of large producers that can affect global supply, export prohibitions can also lead to an increase in global prices. The export prohibition harms domestic raw material producers, as it lowers their surplus, and benefits domestic consumers of the raw material. Its impact is similar to an export tax, except that in the case of an export tax part of the producer (of the raw material) surplus is redistributed to the government in the form of export tax revenue.

Political motivation: Resource nationalism and national politics that focus on benefitting from the natural mineral are the most commonly noted political motivations. However, quantitative restrictions such as export prohibitions are generally not allowed under WTO rules, unless the restrictions are temporary, or applied for national security reasons.

Operational: When export prohibitions have been used as the main tool for industrial development, the results have largely failed. This was noted in the case of Zimbabwe. Export prohibitions, without the existence of domestic capable firms, failed or were suspended. Where domestic capacity did exist or emerged because of the international investor's strategic interest (noted for China and nickel/stainless steel production), export prohibitions were successful in developing value-added activity.

Temporal: The case studies indicate that the imposition of export prohibitions is either:

1) Followed by years of negotiations and counter offers from the existing mining sector – often resulting in suspension or removal of the prohibition, or

2) Investments in domestic activity is announced within a short time-period (2 to 5 years) of the prohibition.

Dynamic: Export prohibitions are not dynamic by nature – it takes time for industrial activity to respond to such measures. In the upstream sector, the volume of production cannot be changed swiftly. For the downstream sector (industrial activity), some changes in production levels can be made in the short-term by utilising existing capacity. The impact of prohibitions can be immediate (in terms of decisions to shut-down operations). Increasing activity will take the medium-term to be become operational.

The ability of an export prohibition to change market dynamics cannot be established by the literature review conducted for this study. The only general comment that can be made is that countries that have used industrial policy for value-added development accompanied by trade policy, show indications that the industrial activity will be sustained over time. Countries that have used trade policy as their primary tool for value-added activity, have not developed industrial activity that will be sustainable, if the protection under the trade restrictions are removed.

3.2 Export taxes

Analytical analysis: Export taxes are not prohibited under the WTO rules. Export taxation is more prevalent in lower-middle income countries and upper-middle income countries. They are commonly used for revenue generation by low-income countries.

In addition to enhancing the fiscus, export taxation is meant to influence the cost of the product, making it more costly to export than diverting to the domestic market. Again, export taxation is more commonly found in upstream segments. For steel/iron-ore products, the use of export taxes is also noted for intermediate products to ensure access to domestically mined ore for the domestic industry. Export taxes are seen to be used with other less restrictive trade tools, such as conditional export prohibitions and licensing requirements.

In upper-middle income countries, minimal levels of export taxes are noted for intermediate products, not significant enough to be considered as restricting trade.

Export taxes will decrease the domestic price of the product, relative to the export price. It functions as a cost subsidy for the domestic producer and encourages exporters to divert some or all their output to domestic producers, assuming that domestic firms can absorb their production.

Political motivation: Revenue generation appears to be the main motivation for the use of export taxation. For shaping industrial policy, they appear to be used as an ancillary tool by developing countries, rather than the main trade policy tool.

Operational requirements: For shaping industrial policy, export taxes are most likely to have an impact when there is functioning domestic activity. Where new investments are being sought, export taxes will impact the company revenue calculations, and companies will prioritise investments in other countries with less fiscal burden. Where choice of country for the investor is determined by other factors (such as proximity to industrial clusters, mineral access etc), export taxes will be considered as part of the costs of doing business.

The experiences of Zimbabwe and Indonesia indicate that export taxes were not successful in driving domestic value-added activity. This is related to two factors: 1) Where other upstream sources exist, downstream actors will change to suppliers in a different region, and 2) if the overall cost of the mineral in the final product is low, some increase in the cost of upstream products will be absorbed by the manufacturer.

Temporal: The basis of determining the tax rate – volume, level of mineral content, market price – differs by country for the upstream segment. Export taxation is a greater issue for the upstream segment, as mineral prices tend to fluctuate more widely than for processed products. In terms of effectiveness, the literature review did not highlight success or failure over time; it is only noted that export taxes are eliminated/reduced for two reasons: 1) They are replaced by export prohibitions; and/or 2) Reduced on final/semi-finished products to increase export competitiveness of the domestic industry by lowering the final price for the international market.

Dynamic: Export taxes have an immediate impact on costs. Therefore, they can be used in the short and medium terms to create structural changes in the domestic economy or the international markets. However,

the extent of this change is determined by its share in costs and the ability of the firm to absorb the cost change.

3.3 Licensing requirements

Analytical analysis: Licensing is a tool for monitoring export activity. Licences can determine which firms within the domestic economy are exporting, the destination for those exports and the nature of the product (sometimes inclusive of its intended use). By themselves, licenses should not be considered prohibitive, unless there is an arduous qualification process associated with them.

For example, in Ghana gold export licences are required for the government to monitor the exports from mining companies, distinguishing it from independent traders. This assists with corporate taxation calculations and monitoring smuggling activity. Saudi Arabia uses export licences on steel products to monitor if the level of local content value-addition requirements is being met (set at 40% in 2016). Morocco uses licences to monitor dual-usage goods, some of which can have security concerns (such as arsenic exports).

Licencing should be considered prohibitive (in the context of domestic value-addition) when the conditionalities attached to it are meant to force domestic activity. In the case of Indonesia, they acted as de facto export bans. In the case of India, they prioritise delivery of downstream products to the domestic market before the remainder can be exported.

A 'qualified list of exporters' – which is similar to a conditional licencing requirement – is noted for use in Guinea, India, Indonesia, Myanmar and Ukraine.

Political motivation: Export licencing is permitted under WTO rules for certain circumstances, such as national security, foreign policy (sanctions and embargoes) and to create transparency in the export of specific products. The use of licences is quite extensive in raw material chains and appears largely to be a monitoring tool.

Operational requirements: The processes and administration of licensing can be cumbersome and therefore requires capacity and capability in implementing licensing schemes. When used specifically for encouraging domestic value-added activity, it is more likely to be used in conjunction with export taxation rather than export prohibition.

Temporal: No particular temporal impacts for licences are noted. A review of the 2009-2022 period (OECD) indicates that once introduced licensing regimes tend to stay, rather than being rolled back.

Dynamic: Licensing, dependent on the purpose, usually provides a preparation period between its announcement and implementation. Its ability to impact existing value-added activity is deemed to be limited, unless inefficiently administered where they become a cost to the company.

3.4 Export quotas

Analytical analysis: Under WTO rules, export quotas are discouraged but not prohibited. Within the cases studied for this report, we did not find any material use of export quotas to promote value-added activity; export prohibition appears to be a more prevalent tool when governments are seeking to control domestic availability of raw materials.

If China is removed from the review, export quotas are only noted for Angola, Belarus, Brazil, Russia, Thailand and Ukraine in 2022. If the products that are used in refineries that produce steel from waste materials are also removed, export quotas are found for gypsum in Thailand and Niobium, tantalum as well as vanadium ores and concentrates in Brazil.

Political motivation: The use of quotas is noted for strategic minerals, where the intermediate/final product serves a strategic industry (such as aerospace or superconductors). The producers and consumers of the downstream product are therefore limited. The political motivation for using quotas is a highly strategic one and is dependent on the country's relationship with its trading partner, who will be impacted by the tool. In the case of Brazil diplomatic relations with the USA and EU have, to some extent, allowed for the use of quotas, whereas in the case of China, this has led to more contestation.

Operational requirements: Quotas are an administrative process and therefore have the same requirements in efficiency as licensing.

Temporal: No particular temporal impacts for quotas are noted. A review of the 2009-2022 period (OECD) indicates that once introduced, quotas tend to remain and are not rolled back.

Dynamic: As with licensing, quota introduction usually provides a preparation period between its announcement and implementation. Its ability to impact existing value-added activity is deemed to be limited, as in practice they have been applied to very limited, strategic minerals.

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