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The research design of downstream minerals and processing locations in Indonesia

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Abstract. Mineral downstream is a strategy to increase the added value of commodities owned by a country. With downstream, exported commodities are no longer raw materials but have become semi-finished goods. The construction of mineral processing facilities is a statutory mandate that must be obeyed and implemented. Mineral raw materials are processed domestically to provide added value and more meaningful benefits for Indonesians. The implementation of various policies recently issued by the Government of the Republic of Indonesia which aims to encourage downstream mineral processing in Indonesia requires research proposals to better back up and sustain policy making in this field. This paper highlights a broader understanding of downstream mineral processing location determination. Regarding to the relationship between trade theory and geographic economics is necessary to get a whole illustration of the elements where mineral processing in downstream industries must be optimized. So, the downstream process will become more attractive for the mining industry.

1 Introduction

The United Nations [1] stated that mineral-producing countries, especially developing countries with abundant minerals, have the potential to industrialize further and diversify into entirely different industries.

Several developing countries in Asia and Africa have issued various policies in the form of regulations or laws to suppress downstream enforcement in mineral processing [2, 3]. The Government of Botswana asked De Beers to cut and polish the diamonds in his own country [2]; differently, the Government of Indonesia banned the export of unprocessed mineral commodities [4,5]; the Zimbabwe Government did the same by banning the export of raw gold [6]. Not all policies issued can run well; for example, the European Union sued Indonesia at the WTO regarding the prohibited of nickel ore export, which work on January 1, 2020. The European Union claims that the Indonesian export ban, local processing and marketing specifications, and export licensing designation that apply to basic materials, including nickel, iron ore, chromium, coal, metal waste, scrap, and coke, are not following Article XI:1 General Agreement on Tariffs and Trade (GATT) 1994. However, the Dispute Settlement Body (DSB) of the World Trade Organization (WTO) has won the EU lawsuit.

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One of the things that caused the defeat of the Indonesian Government was the unpreparedness of the downstream nickel industry in Indonesia.

The problem of developing a mineral processing industry (smelter) in Indonesia arises when each type of mineral is required to increase its added value by law. At the same time, the infrastructure energy is not supported, and the certainty of resources is not yet ready. It has caused investment in the smelter business to become unpleasing, especially for types of minerals: nickel, iron, aluminum, and copper [7]. The policy creates pressure or uncertainty about the return on investment, causing a reduction in foreign investment, straight-forward investing in the mining industry. It is necessary to be careful about the possible impacts such a policy might have and how countries can optimize the impact of their policies. So that the implementation of various policies aimed at encouraging or even forcing downstream processing of minerals properly, research is needed to better inform policymakers in determining whether and how mineral-producing countries can and should intervene where minerals are processed.

Currently, Indonesia has 26 smelters, consisting of 20 nickel smelters, two bauxite smelters, one iron mineral smelter, two copper smelters, and one manganese mineral smelter. The Ministry of Energy and Mineral Resources targets the number of smelters in Indonesia to increase by 17 this year. This effort aligns intending to encourage downstream to provide added economic value to natural wealth, create jobs, and increase state revenues. This amount is insufficient with the number of mineral commodities in Indonesia, and more is still needed. The result of not having achieved the construction of a smelter and the existence of a ban on the export of raw materials has caused disruptions to the production and processing of minerals in Indonesia, which has implications for GDP—from 2014 to 2016, GDP growth from the mining and quarry sector decreased in Indonesia from 0.72 percent and 5.08 percent to 1.0 percent in 2014, 2015 and 2016; due to the unpreparedness of the smelter. In 2022, GDP growth from the mining and quarry sector jumped sharply to 12.22%, or the equivalent of IDR 2,393.4 trillion, due to the operation of several new smelters.

One of the results of the agreement at the meeting of the Ministers of Trade of G20 member countries in 2012 in Mexico shows the importance of countries to play their respective roles in the Global Value Chain (GVC) as providers of raw materials, providers of intermediate products or producers of final products. The involvement of a region in the Global Value Chain will encourage an increase in the regional economy in terms of foreign exchange earnings, GDP, comparative advantage, competitiveness, and employment availability [8].

In various countries, especially developing countries, much research on downstream mineral processing relates to the linkage theory [2, 9]. However, this linkage theory has weaknesses, so the study's depth regarding downstream linkages in particular. This paper adds the parameters of a global value chain (GVC) as the development of the classic linkage theory [10 – 12].

This research is significant to provide input to the Government on how the policies issued will increase the smelter industry competitiveness in Indonesia.

2 Literature review

2.1 GVC analysis

GVC analysis, according to Gereffi and Fernandez [8], is divided into global (top-down) and local elements (bottom-up) (Figure 1). The Global Element dimension refers to international elements determined by the dynamics of the industrial world at the global level. The global element dimension consists of (1) input-output structure, which describes the process of converting raw materials into final products; (2) geographic scope, which describes how the industry is spread and globally entered in which countries various GVC activities; (3) governance structure, which describes how the company controls the value chain. The local dimension describes how individual countries participate in GVCs, divided into (1) upgrading, which describes the dynamic movement in the value chain by examining how producers switch between different stages of the chain, (2) the institutional context in which the industrial value chain embedded in local economic and social elements, and (3) the industry stakeholders' interests, which describes how various local actors in the value chain interact to achieve industrial improvement.

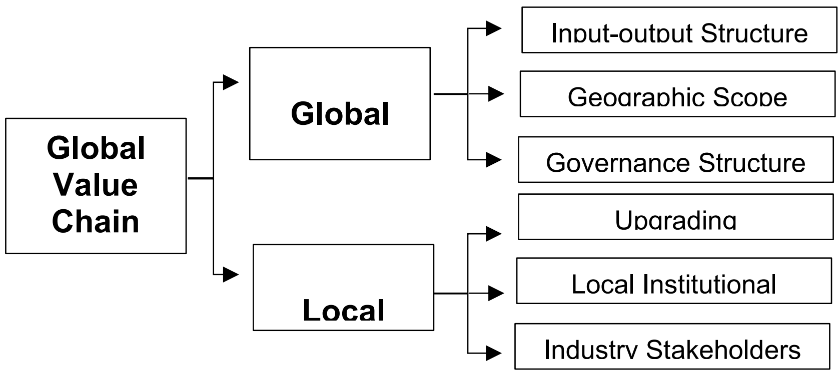

Figure 1. Dimensions of the GVC Analysis [13].

The basis of the GCV model that relates to a nation's success in a particular industry lies in two dimensions: shaping the environment in which firms compete and identifying the attribute of a nation-competitive advantage in six dimensions [8]:

1) *Input-output Structure (IO)*. The business chain of a product or service, from its initial formation from the producer to the hands of the consumer, is a description of the input-output chain.
   Mapping specific activities in the value chain shows that activities carried out in the input, production, and export segments that occur locally and nationally are dominated by tangible activities. Meanwhile, activities carried out in export destination countries' import, retail, and consumption areas are predominantly intangible activities.
2) *Geographic Scope (GSc)*. The existence of transportation infrastructure and the existence of information and communication technology supports the globalization of the minerals industry. The value chain phases cover various local, national, and global geographic areas. The existing intraregional and interregional interactions allow the geographical areas involved in the mineral value chain to influence each other.
3) *Governance Structure (GSt).* As a chain system, the value chain has a coordination system between the actors involved. The coordination system explains how a value chain is controlled by actors directly involved informally or formally from outside the value chain operations. It explains the existence of internal governance and external governance.
4) *Upgrading (Up).* Upgrading is a strategy and efforts made by all relevant stakeholders in improving value chain activities to obtain more benefits in the participation of a product in the Global Value Chain. The form of upgrading carried out by value chain actors is using more modern industrial machine websites for

promotion, strengthening marketing with online marketplaces and modern payment media, and exporting to new potential markets. Upgrading is very close to involving stakeholders outside the value chain who have an interest or function as a determinant of development policy in a region.

5) *Local Institution (LI)*. The local, national, and international conditions and policies must be recognized within the local institutional framework, thus allowing every country to participate in every chain of activities. In other words, GCV must reflect local, social, and institutional dynamics. The dynamics of economic conditions consist of local labor costs, labor availability, skill level, and ease of obtaining further skills and education. And other essential things are tax and employment regulations, subsidies, and providing health facilities.
6) *Industry Stakeholder (IS)*. Apart from the Government through the Ministry of Foreign Affairs, Trade and Industry, the Ministry of Investment, and the Ministry of Education have a role in promoting, educating, and establishing regulations for smelter construction, there are also roles of other stakeholders such as companies, mining industry associations, workers cannot simply be given up their role as stakeholders in the value chain.

2.1 History of smelter in Indonesia

The frequent changes in regulations and policies issued by the Government of Indonesia in the mineral processing industry have hampered the development of smelters. However, the aim is good to emphasize the need for mining companies to build smelters, but the implementation is lacking [14,15]. The mineral processing (smelter) policy has been rolling in line with the passing of the new mining law in 2009. Through Mining Law Number 4 of 2009, the Government requires mining companies to be able to process raw mineral refining before selling it abroad. Article 103, in conjunction with Article 170, expressly instructs every holder of Mining Business Permits (IUP) and Special Business Permits (including Contracts of Work) to build a smelter factory (processing and refining minerals) in Indonesia no later than five years after the Mining Law 2009 promulgated on January 12, 2009.

Then, a derivative policy to regulate technical policies through Government Regulation Number 23 of 2010, where the government regulation regulates the implementation of mining business activities. Policies in this processing industry have undergone many changes. The Ministry of Energy and Mineral Resources' regulation was only issued two years later, on February 6, 2012, and was amended in the same year by regulation no. 7 of 2012; Furthermore, Regulation Number 7 of 2012 was also revised with Regulation No. 11 of 2012 and no—20 of 2013.

Prior to the ban on raw mineral exports, the Government made another revision for the second Government Regulation No. 23 of 2010 through Government Regulation No. 1 of 2014 concerning Increasing Mineral Added Value through Domestic Mineral Management and Refining Activities through Article 12 paragraph 5 stipulates that the deadline for building a smelter is extended again to no later than three years from its issuance on January 11, 2014. In 2017, the Government re-issued government regulations to extend back 5 (five) years of raw mineral export activities through Regulation No. 1 of 2017, issued by the Government, and No. 5 and 6 of 2017 of the Ministry of Energy and Mineral Resources.

3 Methods

The data used in this study are secondary data sourced from the Ministry of Energy and Mineral Resources, the Central Bureau of Statistics (BPS), and primary data sourced from key-person research. Data collection methods are interviews, questionnaires, literature review, and documentation. The number of smelter industries in Indonesia is still minimal, so the number of experts who understand the smelter industry is also limited. Interviews were conducted with industrial entrepreneurs, government, academics, and professionals in the smelter industry. Interviews are carried out by sending questionnaires to the relevant parties; some are done online.

4 Result

In Indonesia, government policies relating to the smelter industry are an exciting topic to study, bearing in mind that policies often change aimed at reinforcing the smelter industry grow quickly, but the reality has not reached well.

During interviews with respondents, almost all dimensions of GVC's Gereffi models found various smelter industry problems. The Input-output (IO) dimension contributes to problems because of reserves-resources uncertainty, supply of raw materials, and waste handling. Added, problems in the geography scope (GSc) dimension, such as the lack of transportation infrastructure, land and ports, availability of electrical energy, and weak information and communication technology support, exacerbate the conditions for developing the smelter industry. In addition, the COVID-19 pandemic and the Ukraine-Russia war prevented smelter construction from going well due to governance dimension (GSt) challenges, such as disruptions to the supply of smelter equipment imported from Ukraine and Russia and the nickel export ban. In the upgrading (Up) dimension, respondents consider that the smelter industry in the future will be better because some obstacles will be minimized. Obstacles in the smelter industry value chain include uncertain availability of raw materials, high and fluctuating prices of raw materials, delays in delivery of raw materials, significant tax rates, uncertainty in permits, less competitive prices for quality production technology, high bank interest rates in Indonesia, damage to goods during export shipments, uncertain world economic conditions, global industry competition, project feasibility, waste, and by-product handling, and domestic competition. Even though it minimizes the obstacles, paying attention to the dimensions of the local institution (LI) is necessary. GVC should involve local institutional dynamics, workforce, skills, and opportunities for further education [16, 17]. Respondents welcomed stakeholders (IS) role in various fiscal and non-fiscal policies. The Government's rules and regulations support the business climate for mineral processing processes such as smelters.

5 Discussion

Although various dimensions in the Global Value Chain analysis indicate problems, such as in reserves-resources uncertainty, supply of raw materials, fluctuations in production prices and raw minerals, waste handling (IO), lack of transportation infrastructure, land, and ports, availability of electrical energy, technology information (GSi), commodity export tires, changes in regulations issued by the Government, domestic product (GSt) prices, these parameters are obstacles that make smelter construction unattractive to various groups of investors, or mining companies. However, upgrading efforts (Up) and improvement programs in the dimensions of local institutions (Li) and stakeholders (Si) help build a better smelter in the future. The progress of smelter construction in several locations demonstrates significant development progress.

Several factors influence the determination of smelter locations from various studies categorized into two broad categories [1, 18]: (1) techno-economic elements and (2) structural elements. Variables in techno-economic elements include energy, the availability of raw materials, complementary inputs, capital, skilled labor, economies of scale, changes in information technology, transportation costs, and proximity to export markets. At the same time, the structural elements consist of investment and tax policies, financial resources, and technology.

It determines the location of smelter construction in Indonesia, such as the construction of the copper smelter of PT. Freeport, located in Gresik Regency, is far from the mining location. At the same time, the construction of nickel smelters is more common in locations near mining sites, both those built in the villages of Sulawesi Island and Halmahera. Likewise, the construction of a bauxite smelter is also approaching the mining location. From various sources, the smelter industry players approach the techno-economic aspect, which is more of an economic location, is more of a consideration in determining the location of the smelter.

Three interrelated research frameworks concerning obtaining a good and effective governance policy framework in determining the location of mineral processing have to do.

- First, it is necessary to map and understand the current global distribution of mineral processing.
  The global distribution of mineral processing and activities concerning available trade and production data are mapped at this stage. Next, determine the correct type of mineral used as the right choice to be generalizable for the main mineral types, which represent an economically significant group of minerals. It is also necessary to map and calculate each stage of mining, production, and distribution for each country to identify our production stage positions.
- Second, we need a theory test that explains the global distribution of mineral processing activities.
  At this stage, it is necessary to determine economic location determinants and test the theory of the global distribution of mineral processing activities. In particular, current linkage theory and the GVC approach [19] are enriched by applying theoretically supported location theory
- Third, comparative studies of various policies made by mineral-producing countries in other parts of the world have to do it. Identifying their policy's advantages and disadvantages under different conditions is necessary.

The primary economic location determinants are the basis for policy choices for mineral-producing countries so that the development of the mineral processing industry becomes attractive. At this stage, investigating and evaluating policies from different extractive industrial countries have been studied.

5.1 Conclusion

This time, research is needed to provide good information to policymakers to encourage increased mineral processing development and whether mineral-producing countries can and should intervene in determining the mineral processing site. Research highlights the linkage of GVC approaches with linkage theory to obtain a complete picture of the economic site determinants of mineral processing. It is necessary to understand in depth the determinants of location relating to determining the appropriate policy in determining the location of mineral processing. This study proposes three stages of research to determine mineral processing locations, which consist of mapping the global distribution of mineral processing, testing economic locations with linkage theory and the Global Value Chain, and researching the policies of other mineral-producing countries. Policymakers' policies must identify and evaluate the policy options available/achievable by mineral-producing countries to attract downstream processing of minerals. This approach will lead to better policies for minerals-dependent developing countries that seek to expand the downstream processing of minerals and help increase the added value of their mineral resources.

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