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Analyzing the impact of Indonesia's mineral export policy using input-output tables

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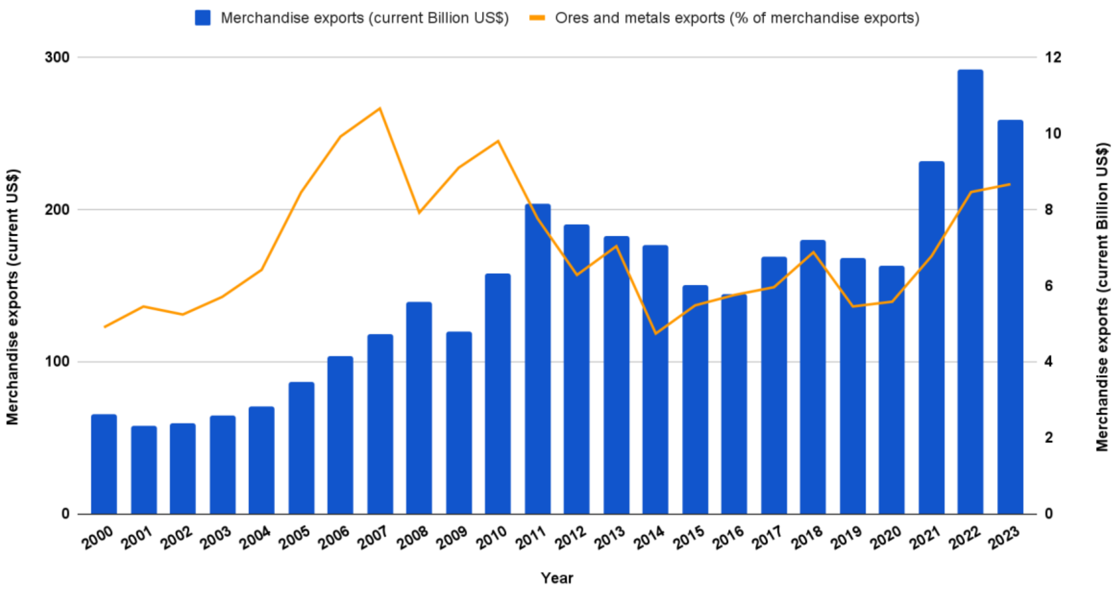
ABSTRACT

Indonesia is a country with abundant mineral resources, which makes a major contribution to the national economy, especially through its export sector. Over the past two decades, the mining sector has consistently contributed an average of 9.77% to the national Gross Domestic Product (GDP). However, the implementation of the raw mineral ore export ban policy led to a decline in the volume and value of mining commodity exports, which directly impacted the sector's contribution to GDP and the national export structure. The policy requires the processing and refining of minerals to be carried out domestically before they can be exported, as an effort to encourage downstreaming and increase added value. This study aims to analyse the impact of the mineral export ban policy on the national economy and examine the linkages between the mining sector and other sectors through the Input-Output (I-O) approach. The method used in this research is Input-Output (I-O) analysis using the 2020 Indonesian I-O Table, which has been aggregated into 29 sectors. The results reveal that the export ban generated a substantial contraction in national output, particularly in coal, manufacturing, transport, and mining services sectors, indicating that downstream capacity remains structurally insufficient. This study contributes by providing updated empirical evidence on the structural constraints of Indonesia's mineral downstreaming strategy and by demonstrating that export restrictions alone are inadequate without parallel expansion of domestic processing infrastructure and intersectoral coordination.

1. Introduction

Indonesia is one of the countries with abundant mineral resources and plays an important role in the global mineral market. In 2020, Indonesia was recorded as the world's largest nickel producer, with a production share of around 31% of total global output, and it is also among the top producers of tin, gold, and bauxite. These mineral commodities contribute to the national economy, particularly through export revenues, positioning Indonesia as a strategic supplier in global mineral supply chains (Chung, 2021). Given Indonesia's high level of dependence on the mining sector, any changes or adjustments to government policies related to mining commodities are crucial for further study. Such analyses are needed in order to understand and estimate the extent of possible impacts on various aspects of the Indonesian economy.

The mining sector plays an important role in the Indonesian economy, both domestically and globally. Figure 1 shows the growth of exports from the mining sector in Indonesia over the period 2000-2023 which averaged 7.01% with an estimated average total export of around 148 billion dollars based on data from the World Bank. The figure also shows the potential impact of the export ban policy on the economy. Total exports and exports from the mining sector declined as shown in 2014 as a result of the export ban policy on several mining commodities. The export ban policy on minerals such as bauxite is also reflected in 2023, where total exports decline and exports from the mining sector do not increase as in previous years.



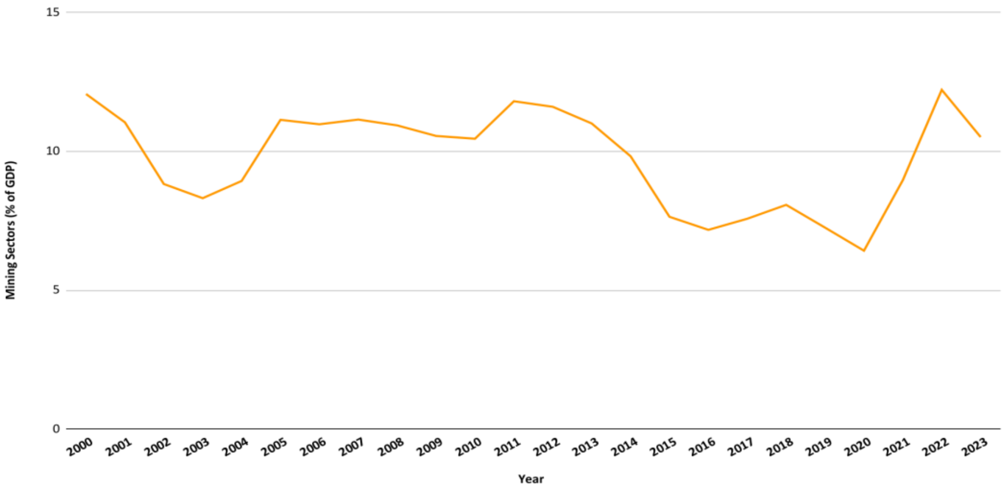
Source: World Bank

Figure 1. Exports of mining commodities in Indonesia 2000-2023

The contribution of the mining sector to Indonesia's GDP from 2000 to 2023 is presented in Figure 2. Over these 24 years, the mining sector in Indonesia contributed an average of 9.77% to Indonesia's GDP. A similar pattern can be observed in the total exports of the mining sector, where its contribution to total national exports also showed a fluctuating pattern over the period from 2014 to 2023. The decline in contribution occurred in the year when the export ban policy on raw mining commodities was implemented, which led to a decrease in the volume and value of mining commodity exports. This condition directly impacts the declining role of the mining sector, both in the export structure and in its contribution to GDP. The decline in the contribution of the mining sector following the implementation of the export ban cannot be understood merely as a short-term market fluctuation, but rather as part of a broader shift in state strategy over the governance of mineral resources. The export ban reflects a shift toward resource nationalism, whereby the state restructures the management of extractive industries by restricting exports of raw materials and redirecting value creation toward domestic processing and industrial development. Resource nationalism can be understood as a state strategy to expand control over resource-based industries and increase the domestic capture of economic benefits from natural endowments (Ostrowski, 2023). This shift repositions the mining sector within the national economy, transforming it from an export-oriented sector into a strategic input for domestic industrialisation.

To analyse in more depth the impact of the mineral export policy, the Input-Output (IO) Table method can be used as a quantitative approach. This method is able to describe the interrelationships between sectors in an economy and measure the direct and indirect effects of a policy change on economic variables such as output, value added, and income. Previous studies by Firmansyah et al (2023) showed that the IO method is very effective in identifying leading sectors and inter-sectoral linkages in the Indonesian economy. In addition, advanced approaches are also used using advanced statistical indices such as Index of Dispersion and Index of Sensitivity to map the relative position of sectors in the economic network. These indices help reveal the sectors that have a greater influence in spreading the impact of economic changes, as well as the sectors that are most vulnerable to the impact. The method has been used in an international study on analysing the financial structure of sectors using open-financial system tables for various Asia Pacific countries (Hagino & Kim, 2021).

This study offers novelty by analysing the impact of the mineral export ban in Indonesia using the 2020 national Input–Output Table, which reflects the current economic structure in the post-pandemic period as well as the early implementation of Law No. 3/2020. In contrast to previous research by Tui & Adachi (2020), which used the 2010 I-O Table, and Dewi et al (2023) and Pratama (2025), which relied on the 2016 I-O Table, this study employs the latest 2020 I-O data that better capture recent structural changes and current policy dynamics. Meanwhile, Woods (2025) examined mineral export restrictions primarily from a geopolitical and international trade policy perspective without analysing their intersectoral transmission within the domestic economy using an Input–Output framework. This study therefore fills both a data and methodological gap by simultaneously integrating output multipliers, gross value added (GVA), household income effects, and sectoral linkage indices (Index of Dispersion and Index of Sensitivity) across 29 aggregated sectors with a focus on major mining commodities. This approach is more comprehensive than Pratama (2025), which mainly highlights the impact of ferronickel exports on manufacturing and imports, and Dewi et al (2023), which only analysed output multipliers and forward and backward linkages in 17 economic sectors.



Source: BPS-Statistics Indoensia

Figure 2. Distribution of the mining sector to Indonesia's GDP trend in 2000-2023

In addition, this study also complements the work of Indriyani & Wijaya (2024) who assessed the impact of export policies on the financial performance of mining companies, as well as Ananda et al (2024) used time series analysis to assess the impact of policies related to nickel ore exports on Indonesia's processed nickel export volume without considering sectoral impacts in the economic system. Thus, this study makes a new contribution through sectoral simulations based on the latest I-O Table in 2020 to assess the overall impact of mineral export policies on the national economy. Based on this, the purpose of this study is to provide an overview of the structure of the Indonesian economy through descriptive analysis and analyse the impact of Indonesia's mineral export policy on the national economy using the 2020 Input-Output Table through a sectoral linkage approach and measurement of economic impacts including the value of the output multiplier coefficient, value added, and household income. The findings of this study are expected to provide an empirical basis for the formulation of a more strategic and sustainable national mineral policy.

2. Literature Review

Input-Output (I-O) tables are systematic representations of the flow of economic transactions between sectors or industries within a given economic area (such as a country) over a period of time, usually in monetary units (Miller & Blair, 2009). I-O tables can be used to analyse the structure of the economy, the interrelationships between sectors, and the impact of economic policies. With this approach, it can be seen to what extent mineral export policies affect the national economy. According to Schuschny (2005) stated I-O tables are based on three main assumptions: homogeneity, proportionality and additivity. The homogeneity assumption means that each sector produces only one type of output with a single input structure, without taking into account variations in production technology within the sector. The proportionality assumption shows that the use of inputs is directly proportional to the amount of output, meaning that any increase in output requires an increase in inputs in a fixed proportion. Meanwhile, the assumption of additivity states that the effect of production activities in various sectors is the sum of the effects in each sector.

Indonesia has a wealth of natural resources in the form of petroleum, natural gas, and minerals that play an important role in supporting national economic growth (Fatih et al., 2026; Randa et al., 2025). Mineral mining and export activities are one of the main sources of state revenue. The Heckscher-Ohlin theory states that a country tends to export products produced by utilising factors of production that are relatively abundant in the country, and import goods that require factors of production that are more limited in availability (Blaug, 2009). Based on Law No. 3/2020, which is an amendment to Law No. 4/2009 on Mineral and Coal Mining, mining businesses are required to carry out processing and refining activities of mining products in the country. This regulation also stipulates a ban on the export of minerals in raw form, as part of the government's efforts to encourage downstreaming and increase domestic added value. This policy is carried out so that the country can optimise existing resources, especially its mineral wealth.

Previous studies that analyse the impact of mineral export policies will be summarised to identify findings that have been produced by previous researchers. Research conducted by Fatma & Rahayu (2021) shows that production in the mining sector has a significant contribution to regional economic growth in Southeast Sulawesi, but does not contribute enough to significantly increase national GDP. In addition, increasing production in the mining sector is not the main key in achieving sustainable economic development. Tui & Adachi (2020) examined Indonesia's mineral export policies using 2010 input-output tables. They found that banning raw material exports can increase domestic value added, and although the mining sector has substantial output potential, its contribution to employment remains limited. Similarly, Dewi et al (2023) used the 2016 input-output table, consisting of 17 sectors, to analyze the nickel ore export ban. Their study showed that the policy increased ferro-nickel exports and enhanced domestic output, reinforcing the importance of downstream linkages.

The analysis of the Australian mining and quarrying sector by Weldegiorgis et al (2024), based on national I-O tables and the partial hypothetical extraction method (P-HEM), found strong backward linkages but weak forward linkages, with the latter being mainly associated with non-metallic materials. These results indicate that, while mining supports upstream supply activities, its contribution to broader downstream industrial integration remains limited. Beyond I–O analyses, several studies have used complementary approaches to evaluate broader economic effects. Samir et al (2024) applied a Computable General Equilibrium (CGE) model to assess Indonesia's mineral export ban on GDP, international trade, and consumer welfare. Their results suggest that the policy raises GDP and improves the trade balance, although short-term consumer welfare declines. Similarly, Rifa'i et al (2025) employed the IndoTERM CGE model, based on 2016 Interregional Input-Output data, to evaluate the economy-wide effects of the nickel ore export moratorium. They found that the moratorium increased exports and stimulated downstream sectors, particularly iron and steel, with the largest benefits observed in Sulawesi, while its impact on national GDP remained relatively small.

Several studies have highlighted the role of trade networks and partial policy interventions. An analysis of global nickel ore trade flows by Dong et al (2021) showed that optimizing these flows can reduce costs and improve resource allocation efficiency. Firdaus et al (2015) argued that partial measures, such as a nickel ore export ban, may negatively affect economic indicators unless complemented by increased activity in the nickel production chain, including investment in downstream processing industries. Likewise, Sugara et al (2024) reported that the 2020 raw nickel export ban, which was implemented to accelerate smelter development and increase domestic value-added, triggered a trade dispute with the European Union. Other studies has also linked mineral export policies to global energy transitions and technological innovation. Islam et al (2024) found that Indonesia's mineral exports are highly responsive to renewable energy expansion in importing countries, highlighting the need to strengthen downstream policies to produce value-added products aligned with the global energy transition. Similarly, Zou et al (2025) highlight that strategic mineral policies emphasizing value-added processing, technological innovation, and the integration of renewable energy can strengthen Indonesia's global competitiveness and foster sustainable economic growth while reducing environmental pressures. Their findings indicate that effective downstream policies must account for both domestic conditions and global economic dynamics in order to maximize economic and environmental benefits. In addition, Rahmawan & Angraini (2021) showed that the manufacturing industry and electricity and gas sectors are key sectors in the economy. The electricity and gas sector has the highest output multiplier value but the lowest Net Trade Balance (NTB), while the agriculture sector is considered the most efficient in creating NTB. The study also found that the largest export linkages occur in the Java region, highlighting regional differences in sectoral contributions.

Other studies highlighted regional and sectoral implications of mineral policies. Sulista & Rosyid (2022) showed that tin mining significantly contributes to GRDP in Bangka Belitung and generates strong backward linkages and positive multiplier effects on the regional economy and household income during 2001–2015, indicating that the province does not experience a resource curse despite the presence of social and environmental challenges. Randa et al (2025) using East Kalimantan's input–output tables, showed that a decline in coal export value led to output contractions across all economic sectors, with the mining and coal sector experiencing the largest impact, accounting for approximately 73.7 percent of total output losses. Their findings highlight the urgent need to develop downstream coal processing and strengthen industrial linkages to mitigate the adverse effects of declining exports. Additionally, a USITC (2024) report found that Indonesia's nickel ore export ban significantly shifted exports from raw ore to processed nickel products, increasing domestic value added and promoting downstream industry expansion. previous studies consistently indicate that mineral export policies, particularly raw ore export bans, can enhance domestic value-added, stimulate downstream industries, and generate positive multiplier effects, although the magnitude of these impacts varies across sectors and regions. Building on these findings, this study complements earlier research by examining the mineral export ban using a 2020 input-output table with 29 aggregated sectors, with a particular focus on the mining sector. By utilizing more recent data than prior studies, this research is expected to provide more relevant and up-to-date findings, directly supporting the analysis of the economic impact of mineral export policies using the I–O approach.

3. Method

3.1. Sector Classification and Aggregation

The main focus of this research is to analyse the contribution of the mining sector to the national economy through the Input-Output approach as follows:

Table 1. Sector Codes for Aggregated Input-Output Table

Original Sector	Sector Name	Sector Code
1–36	Agriculture, Forestry, Fishery	1
37	Coal	2
38–39	Oil and Gas	3
40	Iron Sand and Iron Ore	4
41	Tin Ore	5
42	Bauxite Ore	6
43	Copper Ore	7
44	Nickel Ore	8
45	Other Metals	9
46	Gold Ore	10
47	Silver Ore	11
48–50	Other Minerals	12
51–52	Mining Services	13
53–110, 121–144	Manufacturing Industry	14
111–120	Other Processed Mining Products	15
145–146	Electricity and Gas Supply	16
147-148	Water Supply, Waste Management, Sewage, and Recycling	17
149–153	Construction	18
154–156	Wholesale and Retail Trade; Repairs	19
157–163	Transport and Warehousing	20
164–165	Accommodation and Food Services	21
166–169	Information and Communication	22
170–173	Financial and Insurance Services	23
174	Real Estate	24
175–176	Corporate Services	25
177	Public Administration, Defense, and Compulsory Social Security	26
178, 181	Education Services	27
179, 182	Health and Social Services	28
180, 183-185	Other Services	29

The number of sectors in Indonesia's I-O table, which reaches 185 sectors and requires an aggregation process to simplify the analysis structure without losing the essence of the relationship between sectors. Aggregation is based on the similarity of economic characteristics and their linkages in the production chain. The mining sectors are maintained at a relatively high level of detail so that the contribution of each commodity can be analysed specifically. Meanwhile, non-mining sectors are aggregated into broader groups to maintain a manageable number of sectors and facilitate efficient analysis. The original sector classification of the 185-sector I-O table and its corresponding aggregation into the 29-sector structure used in this study are presented in Table 1.

Table 1 shows the mining sector is grouped in more detail than other sectors in order to maintain the focus of analysis on individual commodities. This approach allows a clearer identification of which sectors have significant direct and indirect contributions to the economy. The more diverse non-mining sectors are grouped based on their interconnectedness and similar role in the economic structure. Aggregation is done conventionally as in Tui & Adachi (2020) without changing the basic relationship between sectors, so that the analysis results can still represent the structural conditions of Indonesia's national economy. The aggregated sector structure is the basis for the preparation of the inverse Leontief table and the calculation of various sectoral linkage indicators and is used to evaluate the strategic role of the mining sector in the Indonesian economy.

3.2. Data

The data used in this study is the 2020 Indonesian Input-Output table consisting of 185 sectors based on basic prices. This Input-Output table is sourced from the Badan Pusat Statistik. Although this study uses the 2020 input–output table, its application remains appropriate because it is the most recent and methodologically validated I–O framework published by BPS. Consistent with the widely accepted assumption in input–output analysis that technical coefficients (matrix A) remain relatively stable over the short to medium term (Dobrescu, 2013), the 2020 table continues to provide a credible representation of inter-sectoral relationships. By integrating 2023 export differentials into this structure, the analysis effectively combines updated export data with the latest available technological coefficients. Under these conditions, the 2020 I–O table provides a sound and defensible basis for assessing the economic impacts of Indonesia’s mineral export policy.

3.3. Linkage Analysis

Linkage analysis is an important analysis for an economy to show the role of sectors producing goods and services (Kula, 2008). One of the most widely known methods for analysing the linkages between economic sectors is linkage analysis with index of dispersion and index of sensitivity. The index of dispersion is a measure of the impact of changes in final demand in a sector on aggregate output. The higher the value, the greater the sector's influence on the sectors providing its inputs. This means that the sector can stimulate progress in the sectors providing intermediate inputs. The index of dispersion can be calculated as follows:

$$IOD_j = \frac{\sum_{j=1}^{n} b_{ij}}{\frac{1}{n}\sum_{j=1}^{n} b_{ij}} \tag{1}$$

where b_{ij} represent the element of the inverse leontief matrix and n is the total number of sectors. Meanwhile the index of sensitivity is a measure of the impact on the output of a sector as a result of changes in final demand in each sector. The higher the value, the greater the sector's influence on the sectors that use its output. This means that the sector can stimulate progress for the sectors that use its output. The index of sensitivity can be calculated as follows:

$$IOD_i = \frac{\sum_{i=1}^{n} b_{ij}}{\frac{1}{n}\sum_{i=1}^{n} b_{ij}} \tag{2}$$

where b_{ij} represent the element of the inverse leontief matrix and n is the total number of sectors.

3.4. Impact Analysis

Impact analysis can be conducted by analysing the input-output (I-O) table using multiplier effects. Impact analysis aims to measure the total effect in terms of output, labour, income, and value added when one unit of input increases the output of a particular sector (United Nations, 1999). The multiplier effect also measures the possible impact of a change in an exogenous variable such as final demand on sectoral output variables. The multiplier effect consists of output multiplier, income multiplier, and labour multiplier. To analyze the impact of the export ban policy, multipliers are very relevant to use. Some of the multipliers used in this study are: a). Output multiplier, the multiplier shows the total output of the sector required to produce one additional unit of output, when there is a one-unit increase in final demand. This multiplier is calculated as the sum of the columns of the inverse

Leontief matrix $OM_j = b_{ij}$, where b_{ij} is the element of the inverse Leontief matrix; b). Income multiplier, that a change of one monetary unit of labour compensation from one sector will increase the overall total income. According to Miller & Blair (2022) the type-I income multiplier is calculated as $IM_j = \frac{\sum_{i=1}^{n} v_i b_{ij}}{v_j}$, where b_{ij} represent the element of the inverse leontief matrix and $v_{i,j}$ is the ratio of labour compensation to total inputs; c). Value added multiplier is a one monetary unit change in the final demand of a sector will increase the total value added as a whole. This multiplier is calculated as $VAM_j = \frac{\sum_{i=1}^{n} g_i b_{ij}}{g_j}$, where b_{ij} represent the element of the inverse leontief matrix and $g_{i,j}$ is the ratio of total primary inputs to total inputs.

3.5. Impact Analysis on Implementation of Mineral Export Policy

This study simulates the impact of the mineral export ban policy through the Input-Output approach by injecting the difference in the value of mineral commodity exports in 2023 against 2022 as a shock into final demand. Export data is obtained from UN Comtrade for several mineral commodities that should not be exported, namely nickel, bauxite, tin, copper, coal, steel, and gold. Miller & Blair (2022) states that the injection value is then calculated to assess its impact on the national economy using the following formula:

$$\Delta X = (I - A)^{-1}.\Delta F \tag{3}$$

Where ΔX is the change in sector output, I is the identitiy matrix, A for technology coefficient matrix and ΔF is the change in final demand.

4. Results and Discussion

4.1. Descriptive Statistics

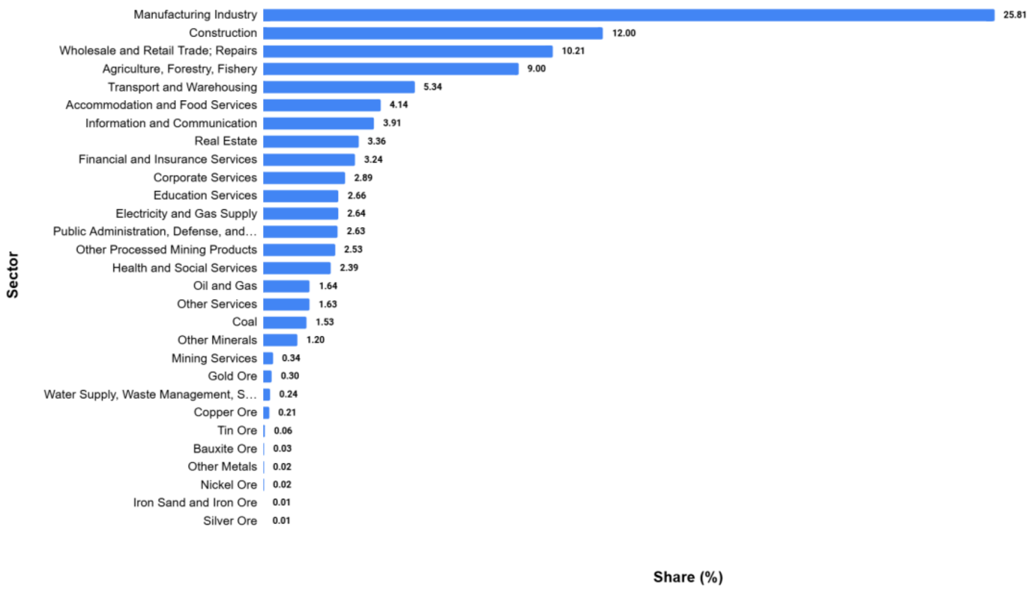
Descriptive analysis is conducted to understand the basic structure of the Indonesian economy as reflected in the 2020 Input-Output Table. The purpose of this analysis is to provide an overview of the characteristics of the Indonesian economy, the structure of the economy by business category,

Description	Value	%	Description	Value	%
Intermediate Demand	13,548,945,435	43.53	Domestic Output	28,700,250,526	92.22
Household Consumption	8,594,787,270	27.62	Imports	2,422,144,296	7.78
Non-Profit Institution Consumption	201,653,378	0.65	Total	31,122,394,822	100.00
Government Consumption	1,394,875,537	4.48			
Establishment of Gross Domestic Fixed Capital	4,749,305,891	15.26			
Changing Inventories	51,830,114	0.17			
Exports	2,684,657,425	8.63			
Total	31,122,394,822	100.00			

Source: Indonesia Input-Output Table (2020)

The balance of goods and services in the Indonesian economy in 2020 is presented in Table 2. The total supply of goods and services produced by Indonesia in 2020 reached Rp31,122 billion. Domestic output accounted for the largest share of total supply, at 92.22%, indicating that Indonesia remained highly dependent on domestic demand and inter-sectoral inputs. In terms of usage, intermediate demand has the largest share of 43.53% which means that almost half of all economic activity in Indonesia is inter-sectoral production. However, our focus here is on Indonesia's exports which reached 8.63%. Saltarelli et al (2020) explained that a country's exports reflect the level of competitiveness of a commodity and are a means of evaluating differences in production capabilities between countries. The relatively small export contribution to the total availability of goods and services reflects the fact that value-added processing in Indonesia's mining sector remains limited. Although Indonesia is one of the world's major producers of coal, nickel and copper, most mining products are still exported in the form of raw materials or primary minerals, rather than high-value processed products. Dependence on raw material exports makes the sector vulnerable to global price fluctuations and weakens Indonesia's bargaining position in international supply chains.

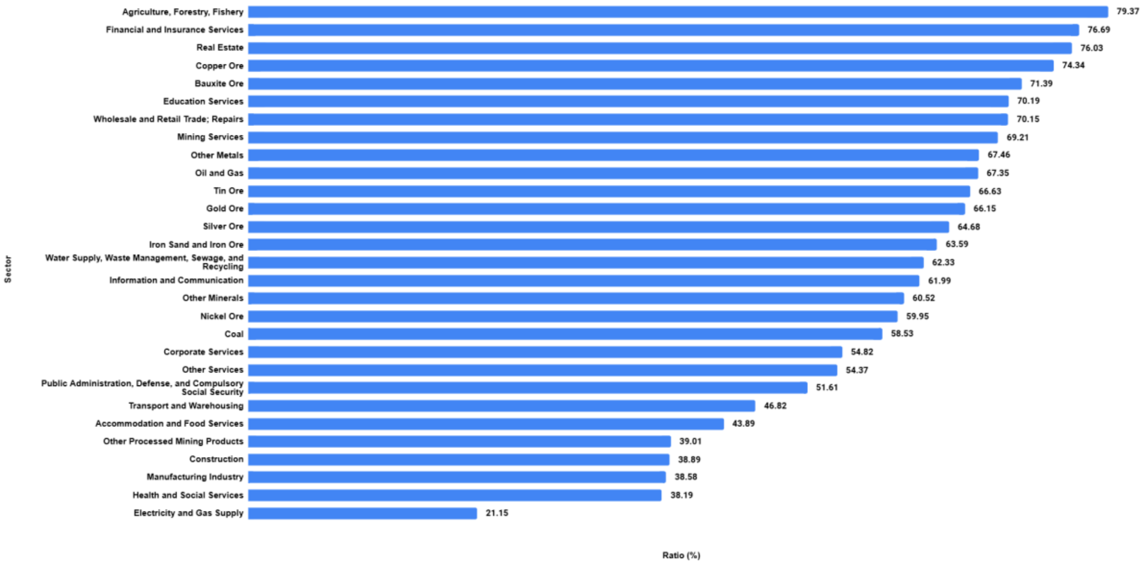
Limited processing and refining facilities for domestically mined mineral ores prolong the dependence on other countries to produce final products. This results in a loss of potential foreign exchange and narrows the opportunity to increase GDP from the downstream mining sector. Therefore, the government's efforts to encourage downstream mining through banning the export of raw materials and providing incentives for the processing industry need to be strengthened. This step is not only to increase economic added value, but also as a long-term strategy in creating a stronger and more sustainable national industrial structure.



Source: data processed

Figure 3. Economic Structure by 29 Sectors in Indonesia in 2020

The economic structure of Indonesia in 2020 is presented in Figure 3. The manufacturing industry, construction, and wholesale and retail trade, repair of cars and motorcycles made the largest contributions to the Indonesian economy, accounting for 25.81%, 12.00%, and 10.21%, respectively. The business field that has the smallest contribution to the economy in Indonesia is silver ore at 0.01% followed by the iron sand and iron ore sector (0.01%), and nickel ore (0.02%). Manufacturing has the highest share because it transforms diverse inputs into high-value products through long and complex production chains, while silver ore has the lowest share because it is exported in minimally processed form with very limited domestic value-added. Meanwhile, the gold ore sector made the largest contribution to the Indonesian economy among all other mining ore categories, at 0.30%. Figure 3 indicates that of the total production value generated by the national economy, 0.30% came from gold ore extraction activities. Despite its relatively small value compared to key sectors such as manufacturing, construction, and trade, gold ore is the largest contributor among all other raw mining ore categories. This reflects that the gold ore sector has a higher economic value than other mining commodities. A study on the impact of gold mining in several regions in Indonesia and found that gold mining can increase the income of miners and open up new jobs by making some residents become workers in the mining area (Fadilah & Nurbaiti, 2023). hese effects indicate that the contribution of gold mining should be viewed not only from its share in aggregate production, but also from its broader role in stimulating regional economic activity. Thus, despite its relatively small contribution to total national output, the gold ore sector plays an important role in the economic structure of Indonesia's mining sector and has the potential to be further developed through downstream processing. Strengthening downstream activities may increase domestic value added, reduce dependence on the export of raw materials, create additional employment opportunities, and enhance the contribution of the gold industry to broader economic development.



Source: data processed

Figure 4. Gross Value Added ratio by 29 Sectors in Indonesia 2020

The GVA ratio of each business field in Indonesia in 2020 is presented in Figure 4. The sector with the largest GVA contribution to the Indonesian economy is agriculture, forestry, and fisheries, accounting for 79.37%, while the electricity and gas procurement sector has the lowest GVA contribution, at 21.15%. The lowest contribution in the raw ore category of mining products was occupied by nickel ore, which only contributed 59.95% followed by other minerals and iron sand and iron ore at 60.52% and 63.59% respectively. The low GVA ratio, especially in nickel ore, occurs because Indonesia tends to export in the form of raw concentrates, without being processed domestically first. This of course causes the added value that should be enjoyed by Indonesia, to be enjoyed by importing countries. This is in line with research by Rahmahwati et al (2022) which shows that the lack of smelter development and mining ore processing plants causes Indonesia to depend on imports of semi-finished products to meet the needs of downstream industries, even though the potential for local added value is very large. Increased investment in the construction of processing and refining facilities is crucial so that Indonesia can optimally utilise the potential of mineral resources. This step will not only strengthen the independence of the national industry, but also increase the competitiveness of domestic products in the international market and encourage an economic shift towards industries that are oriented towards creating added value.

4.2. Linkage Analysis

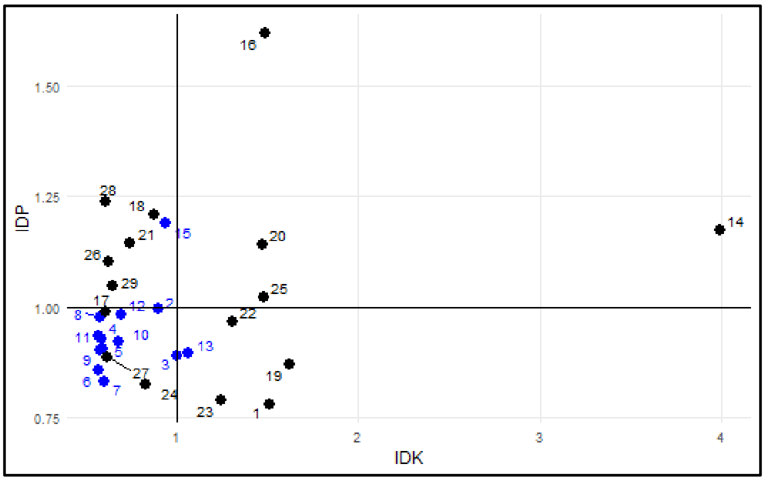
The one sector will have an effect on other sectors. When the output of sector A increases, the demand of sector A for the output of other sectors used as its production input will also increase. Meanwhile, when the output of sector A increases, there will be additional products that can be used as inputs for other sectors.

Table 3. Sector Classification Based on Sensitivity and Dispersion Index

		Index of Sensitivity	
		Low (<1)	High (>1)
Index of Dispersion	Low (<1)	(IV) Generally independent	(III) Dependent on interindustry demand
	High (>1)	(II) Dependent on inter-sector supply	(I) Generally dependent

Source: data processed

To measure the value of forward linkage and backward linkage, in Drejer, Hirschman uses a measure calculated by Rasmussen, the index of dispersion to measure backward linkage and the index of sensitivity to measure forwards linkage (Drejer, 2002). These measures are equal to the normalisation of the forward linkage and backward linkage measures performed (Miller & Blair, 2009). Table 3 shows when both IDP and IDK values are less than one, the sector is independent of other sectors. Meanwhile, if the IDP value is less than one, but the IDK value is more than one, then the sector is dependent on the demand of other sectors, which means that the output of the sector is needed as input from other sectors. If the IDP value is less than one, but the IDK value is more than one, then the sector is dependent on the supply of other sectors' products, thus requiring many inputs from other sectors. Meanwhile, if both IDP and IDK values are more than one, then the sector is dependent, which means that the sector is highly related to other sectors.



Notes:
1. Agriculture, Forestry, Fishery
2. Coal
3. Oil and Gas
4. Iron Sand and Iron Ore
5. Tin Ore
6. Bauxite Ore
7. Copper Ore
8. Nickel Ore
9. Other Metals
10. Gold Ore
11. Silver Ore
12. Other Minerals
13. Mining Services
14. Manufacturing Industry
15. Other Processed Mining Products
16. Electricity and Gas Supply
17. Water Supply, Waste Management, Sewage, and Recycling
18. Construction
19. Wholesale and Retail Trade; Repairs
20. Transport and Warehousing
21. Accommodation and Food Services
22. Information and Communication
23. Financial and Insurance Services
24. Real Estate
25. Corporate Services
26. Public Administration, Defense, and Compulsory Social Security
27. Education Services
28. Health and Social Services
29. Other Services

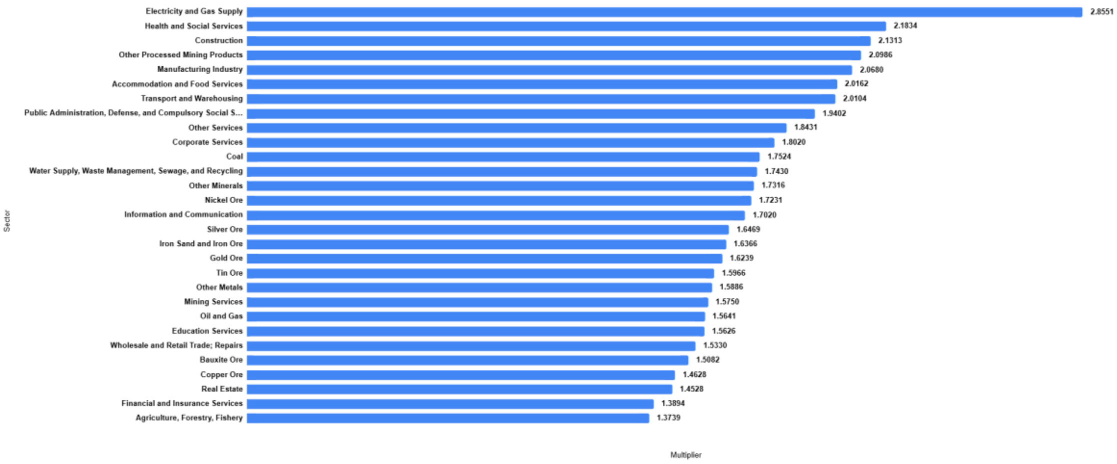
Source: data processed

Figure 5. Distribution of Economic Sectors Based on the Index of Sensitivity (IDK) and Index of Dispersion (IDP) by 29 Sectors in Indonesia in 2020

The electricity and gas procurement sector (16), manufacturing industry (14), transport and storage (20), and company services (25) are positioned in Quadrant I, as shown in Figure 5. This indicates that these four sectors are strongly interconnected with and influence other sectors, and are therefore considered important and key sectors. The health services and social activities (28), other services (29), government administration, defence and compulsory social security (26), construction (18), provision of accommodation and food and beverages (21), and other processed mining products (15) are among the sectors that depend on the supply of other sectors. Focusing on the other processed mining products sector (15) which shows a high level of dependence on the supply of other sectors. This indicates that the sector is unable to fulfil its input needs independently and relies heavily on upstream linkages from other sectors to carry out its production activities. This dependency generally reflects the complexity of long supply chains, where the main and supporting raw materials come from outside the sector itself. This kind of dependency can be a positive potential as it opens up opportunities for collaboration between sectors, but on the other hand increases vulnerability in the event of a disruption in the input chain. The information and communication sector (22), agriculture, forestry and fisheries (1), financial and insurance services (23), mining services (13), wholesale and retail trade and repairs (19) are among the sectors that depend on inter-sectoral demand, meaning that the output of these sectors is needed by other sectors. The rest of the sectors are independent, or less related to other sectors. Focusing on the raw ore sector of mining products, coal (2) is a sector that depends on the supply of other sectors, while other mining products are independent or less related to other sectors.

4.2. Impact Analysis

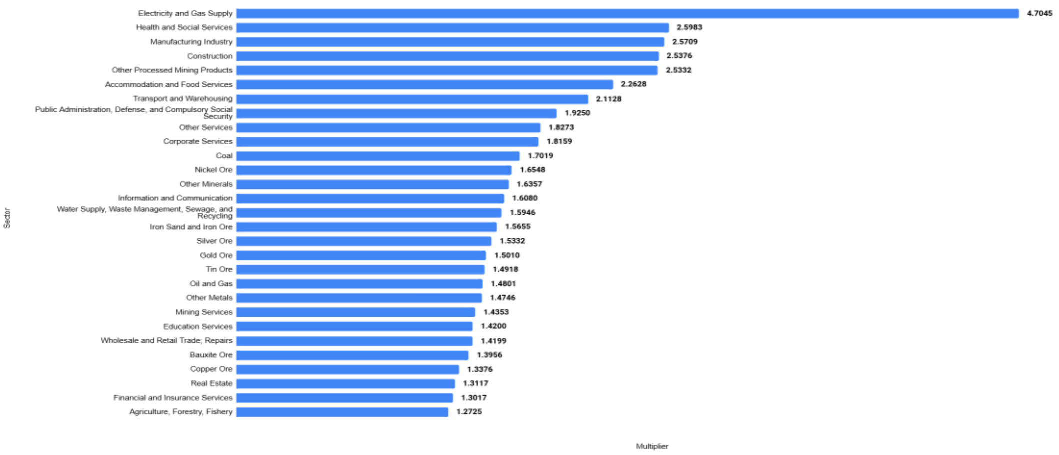
The output multiplier or more widely known as the Leontief multiplier is a very useful tool in analysing the impact of a sector on the overall economy of a region (Bess et al., 2011). Figure 6 shows the interconnectedness of a sector in producing output using inputs from other sectors. The electricity and gas procurement sector has the largest output multiplier at 2.8551 and the agriculture, forestry and fisheries sector the smallest at 1.3739. Nickel ore has the largest multiplier categorised under raw mining products. The multiplier value of 1.7231 means that every one unit increase in the final demand for Nickel ore will increase the total production of the economy as a whole by 1.7231 units. However, if the raw mining products are processed first, it will produce a greater impact. This is reflected in the output multiplier of the Other Processed Mining Products sector, which is 2.0986. The government policy regarding the prohibition of exports of raw mining products is the right step because by processing mining products first, it will bring higher added value. According to Gul (2022) the results of this study with research on further processing of mining products in the form of marble provides exponential socio-economic benefits to a region. This shows that downstreaming not only impacts aggregate economic growth, but also the welfare of communities around mining areas. Therefore, encouragement for investment in the mining processing industry needs to be strengthened as a long-term sustainable development strategy.



Source: data processed

Figure 6. Leontief Multiplier by 29 Sectors in Indonesia 2020

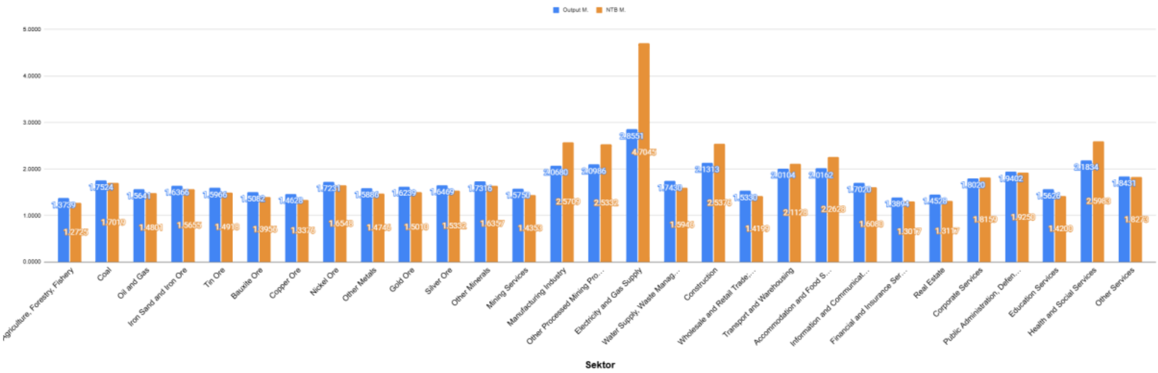
The highest GVA multipliers are recorded for electricity and gas procurement, health services and social activities, and the manufacturing industry, as presented in Figure 7, with multiplier values of 4.7045, 2.5983, and 2.5709, respectively. On the other hand, agriculture, forestry and fisheries have the lowest multiplier value of only 1.2725. According to Soelistijo et al (2015) shows the mineral mining sector's value-added multiplier was 1.2637, substantially less than figures found in downstream industries like the food and beverage sector. This disparity highlights the necessity of downstreaming.



Source: data processed

Figure 7. GVA Multiplier by 29 Sectors in Indonesia 2020

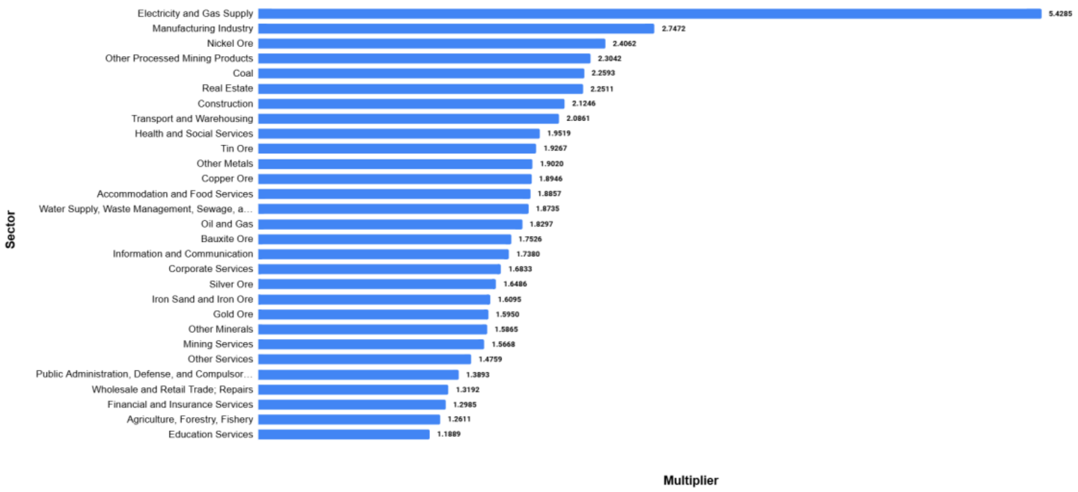
Figure 8 shows the output multiplier and Gross Value Added (GVA) multiplier of business fields in Indonesia to the total economy in 2020. Based on the figure, the sector that has the largest output multiplier value is the electricity and gas procurement service provider, which is 2.855. If observed, the GVA multiplier value of the electricity and gas procurement service provider sector also has the highest multiplier value compared to other sectors at 4.704. Furthermore, the sector that has the smallest output multiplier value is agriculture, forestry, and fisheries at 1.373. If observed, the GVA multiplier value of agriculture, forestry, and fisheries sector has the lowest multiplier value compared to other sectors at 1.272.



Source: data processed

Figure 8. Output Multiplier and GVA Multiplier by 29 Sectors in Indonesia 2020

As shown in Figure 8, sectors with relatively large output multiplier values tend to also have large GVA multiplier values. Conversely, sectors with relatively small output multiplier values tend to have correspondingly small GVA multiplier values. However, the findings contrast to Logaritma & Dwi Wulandari (2022) found a relatively large output multiplier value in the electricity and gas procurement sector but a relatively smaller GVA multiplier value compared to other sectors. Sectors with high output multipliers do have the potential to drive broad economic growth, but to improve domestic welfare and income, it is also necessary to focus on sectors with high GVA multipliers. Therefore, in development planning, it is not enough to consider the magnitude of a sector's influence on total output, but also the extent to which the sector is able to create added value in the local and national economy.



Source: data processed

Figure 9. Household Income Multiplier by 29 Sectors in Indonesia 2020

The electricity and gas supply sector has the highest household income multiplier impact, at 5.42, followed by the manufacturing industry and nickel ore sector, with multiplier values of 2.74 and 2.40, respectively, as shown in Figure 9. This suggests that any additional final demand that occurs in these sectors will lead to a relatively larger increase in household income for that sector in the economy compared to other sectors. In contrast, sectors such as education services (1.24) and agriculture, forestry and fisheries (1.26) have the lowest multiplier values, reflecting the small contribution to total income from each additional unit of income received. In general, the manufacturing and energy sectors tend to have higher income multipliers than the traditional services and financial sectors, signalling that the interconnections between production sectors in the manufacturing and energy sectors are much stronger in creating income. Meanwhile, the nickel ore sector has the largest household income multiplier value in Indonesia among all other mining ore categories, at 2.40. This finding is in line with Yaqin & Mu'min (2026) which shows that the nickel ore sector has an income multiplier value of 1.959, higher than other raw material mining sectors such as iron ore and iron sand. This indicates that the nickel ore sector has a higher ability to transmit an increase in final demand into income for households.

4.4. Impact Analysis on Implementation of Mineral Export Policy

The impact analysis is conducted to identify the magnitude of changes in economic output caused by changes in final demand, through an injection approach to the export value of mineral commodities that are prohibited from being exported. The value of change is extracted from the difference between exports in 2023 and 2022. This approach allows the analysis of not only the direct impact on the mining sector, but also on other sectors connected in the production chain through inter-sectoral linkages in the economic system.

Table 4. Change in Final Demand

Sector	Change on Final Demand (Million IDR)	Change on Output (Million IDR)
Agriculture, Forestry, Fishery	0.00	-7,069,198.98
Coal	-185,595,972.56	-193,226,072.53
Oil and Gas	0.00	-2,437,938.65
Iron Sand and Iron Ore	-287,085.61	-324,340.48
Tin Ore	-0.24	-51,770.07
Bauxite Ore	-8,478,052.02	-8,505,847.19
Copper Ore	-14,018,693.82	-14,164,984.43
Nickel Ore	3.21	-20,390.52
Other Metals	0.00	-19,086.28
Gold Ore	-2,737,952.20	-3,040,671.78
Silver Ore	0.00	-6,691.22
Other Minerals	0.00	-533,997.37
Mining Services	0.00	-16,002,871.57
Manufacturing Industry	0.00	-36,725,098.00
Other Processed Mining Products	0.00	-2,298,328.26
Electricity and Gas Supply	0.00	-4,036,014.62
Water Supply, Waste Management, Sewage, and Recycling	0.00	-168,678.77
Construction	0.00	-2,430,209.91
Wholesale and Retail Trade; Repairs	0.00	-11,769,361.16
Transport and Warehousing	0.00	-22,805,850.29
Accommodation and Food Services	0.00	-776,303.45
Information and Communication	0.00	-7,258,083.18
Financial and Insurance Services	0.00	-8,328,705.77
Real Estate	0.00	-3,610,888.59
Corporate Services	0.00	-15,881,666.73
Public Administration, Defense, and Compulsory Social Security	0.00	-582,101.75
Education Services	0.00	-446,893.04
Health and Social Services	0.00	-429,195.37
Other Services	0.00	-495,371.20
Total		-363,446,611.16

Source: data processed

Table 4 shows the change in final demand due to the implementation of mineral export policy causes a decrease in output in various sectors. The simulation causes a decrease in total output of around 363.45 trillion IDR. The highest decline in output can be seen in the coal sector, which is around 193.23 trillion IDR. This value indicates that coal has a high multiplier value. In addition, the raw ore sector is significantly affected, especially copper ore and bauxite ore, which experienced a decline in output of 14.17 trillion IDR and 8.51 trillion IDR, respectively. This decline in output in the upstream sector had a chain effect on the downstream sectors. The manufacturing industry experienced a decline in output of 36.73 trillion IDR, followed by the transport and storage sector at 22.81 trillion IDR and mining services at 16.00 trillion IDR. However, the simulation results only show the effect of the decline in output due to the implementation of the mineral export ban policy, because the calculation does not include minerals that are actually allocated for domestic processing. This causes the estimated contribution of the mineral sector to the economy to appear to decrease, even though most of the minerals do not disappear from the economic system, but rather shift the purpose of use from exports to domestic processing (Lunku et al., 2026).

Although the IO model shows a decline in output following the mineral export ban, this reduction reflects a modeling constraint in which minerals redirected to domestic processing are not counted as sectoral output losses. In reality, minerals do not disappear from the economic system but shift from export markets into downstream industries, which may generate higher value added when domestic processing capacity is adequate. This interpretation is supported by Samir et al (2024), who show through a CGE analysis that redirecting raw minerals to domestic processing can strengthen Indonesia's macroeconomic performance by increasing value added, enhancing inter-sectoral linkages, and improving long-term welfare. In addition Tui & Adachi (2020) using an Input–Output framework similar to this study, demonstrate that Indonesia's mineral export restrictions tend to shift economic activity toward domestic industries and strengthen downstream sector linkages, although short-term output contractions may occur in upstream sector. Furthermore, the analysis by Zou et al (2025) supports this view by showing that strategic mineral policies including export restrictions, can enhance long-term economic competitiveness when paired with innovation, renewable energy integration, and downstream industrial development, even if short-term adjustments occur during the transition. Collectively, these studies indicate that the apparent contraction observed in IO-based simulations should not be interpreted as an actual economic loss, but rather as a structural shift that can yield greater long-term benefits if downstream capacity is sufficiently developed.

5. Conclusion

This study examined the economic impacts of Indonesia's mineral export ban policy using the 2020 Input–Output Table and a 29 sector aggregated classification. The results show that the policy generated a significant contraction in total economic output, estimated at approximately IDR 363.45 trillion, with the largest negative effects concentrated in the coal, manufacturing, transportation, and mining services sectors. At the same time, the analysis revealed that the nickel ore sector has the highest output and household income multipliers among raw mineral commodities, while processed mining industries exhibit substantially higher value-added multipliers. These findings confirm that, although the export ban reduces short-term output in upstream mining activities, the policy has the potential to shift the economic structure toward higher-value-added activities through downstream processing if adequate industrial capacity is in place. From a practical perspective, the findings imply that the success of the export ban policy depends less on the prohibition itself and more on the speed and scale of domestic downstream development. Policy makers should prioritize accelerated investment in smelting and refining infrastructure, improvements in logistics and energy supply, and stronger coordination between the mining, manufacturing, and energy sectors. Fiscal incentives, streamlined licensing systems, and support for technological upgrading are critical to reducing transitional economic losses and ensuring that redirected mineral flows are absorbed efficiently by domestic industries. Without these supporting measures, the export ban risks generating prolonged output losses and weakening sectoral linkages rather than strengthening them.

This study has several limitations. First, the simulation captures only the negative shock from reduced export demand. It does not fully include the reallocation of raw minerals into domestic processing streams. As a result, the estimated impacts likely overstate economic contraction and understate potential downstream gains. Second, the I-O model uses fixed technical coefficients. It does not consider price adjustments, substitution, or dynamic investments. Third, the analysis relies solely on the 2020 national I-O table. This may not fully reflect structural adjustments after major post-pandemic and policy transitions. Future research should build on this study by utilizing more detailed and disaggregated data to gain a deeper understanding of how mineral export restrictions impact industrial development over time. Future studies can utilize firm-level data to investigate whether downstream processing actually enhances productivity, facilitates technology adoption, and strengthens domestic industrial capacity, rather than merely shifting dependence within value chains. Stronger causal research designs are also needed to clearly distinguish the effects of export restriction policies from global commodity price movements and external economic shocks. In addition, greater attention should be given to institutional and governance factors, such as policy consistency and investment certainty, to better explain variations in policy effectiveness across countries and over time.

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Declarations

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