

Research Article

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Input–Output Analysis: Measuring the Multiplier Effect of The Mining Sector on The Economy of East Kalimantan

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Abstract: *The economy of East Kalimantan remains highly dependent on the Mining and Quarrying sector; however, in recent periods, the role of other sectors, such as the Manufacturing sector, has begun to strengthen. This study aims to analyze the linkages between the Mining and Quarrying sector and other sectors in the East Kalimantan economy, as well as to measure its impact on output, income, and employment. The method used is Input-Output analysis through forward and backward linkages, as well as labor and income multipliers. The results show that the Mining and Quarrying sector has strong forward linkages, with a Forward Linkage value of 2.7086, and backward linkages of 1.4138. This indicates that the mining sector plays a crucial role as a provider of inputs to other sectors while also serving as a user of inputs from supporting sectors. In terms of employment, the mining sector employs only about 0.40 people per Rp1 billion of output, reflecting the sector's capital-intensive nature. These findings underscore the need to strengthen downstream processing, deepen local supply chains, and diversify labor-intensive sectors to foster more inclusive and sustainable economic growth in East Kalimantan.*

Keywords: *Input-Output; mining sector; intersectoral linkages; labor; East Kalimantan.*

Introduction

East Kalimantan is one of the provinces whose economic structure has historically been heavily influenced by the mining and quarrying sector. In real terms, based on the Regional Gross Domestic Product (RGDP) at 2010 constant prices (ADHK), the value added by the mining sector in 2024 was recorded at Rp264.96 trillion, or nearly half of East Kalimantan's total real RGDP, which reached Rp570.82 trillion. The significant role of the mining sector indicates that East Kalimantan's economic activity remains highly sensitive to dynamics in the extractive sector, whether stemming from changes in global demand, production disruptions, or commodity cycle fluctuations. Therefore, changes in the mining sector's performance have the potential to have a broad impact on the stability and overall performance of the regional economy.

As of 2025, East Kalimantan's economic development shows early indications of shifting sectoral dynamics. Although East Kalimantan's GRDP (2010 ADHK) continues to grow positively on an aggregate basis, the mining sector's performance has consistently shown a decline. Data from the Central Statistics Agency (BPS) show that the Mining and Quarrying sector contracted by -0.58% (year-on-year) in the first quarter of 2025, followed by a contraction of -0.13% (year-on-year) in the second quarter of 2025, and contracted again by -0.19% (year-on-year) in the third quarter of 2025 (BPS, 2025). This decline over three consecutive quarters indicates that the drop in mining performance is not a temporary phenomenon but rather part of the structural dynamics of East Kalimantan's economy. At the same time, total GRDP continued to grow in the range of 4–5 percent (year-on-year), indicating that other sectors played a role in underpinning real economic growth (BPS, 2025).

In the literature on development economics, this condition is often associated with the process of structural change—that is, the shifting roles of economic sectors in driving growth over time (Chenery & Syrquin, 1975). However, structural change does not always occur automatically or in a linear fashion. Each sector's response to the weakening of the primary sector may vary, depending on the degree of sectoral interdependence, the structure of final demand, and the investment patterns emerging in the region. Therefore, although some non-mining sectors have shown relatively better performance, these dynamics cannot yet be directly interpreted as indicating a definite direction of economic transition.

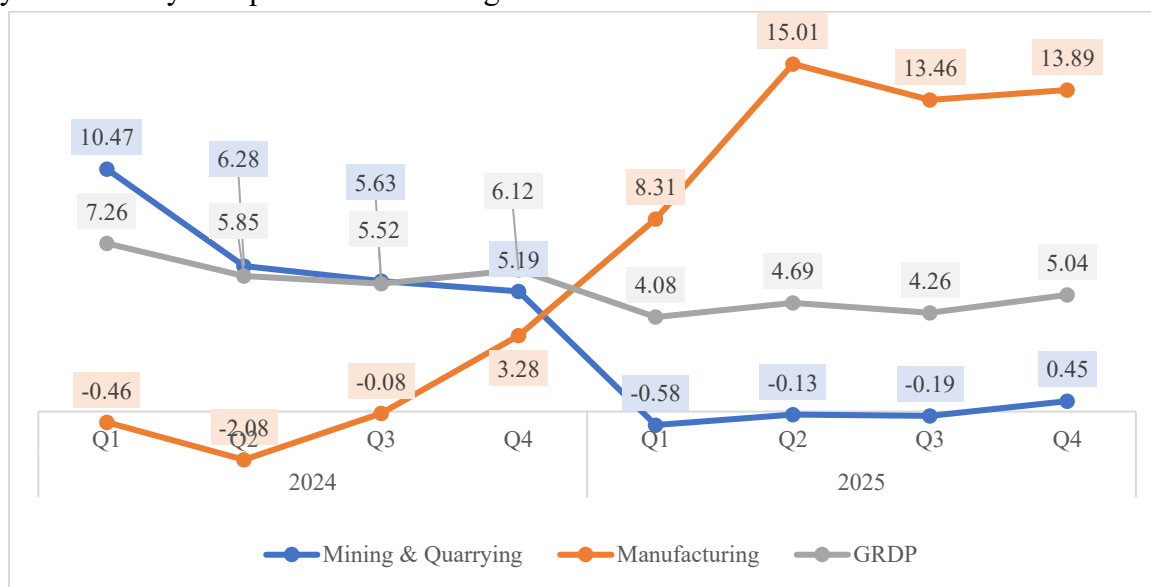


Figure 1. Table of Sectoral Economic Growth in East Kalimantan (year-on-year)
Source: East Kalimantan BPS, 2025 (processed)

A descriptive approach based on changes in ADHK GRDP can illustrate shifts in sectoral performance but is insufficient to explain how the impact of the mining sector's decline spreads to other sectors in the regional economy. According to the theory of sectoral linkages (backward and forward linkages) introduced by Hirschman (1958), a decline in activity within a major sector can generate indirect effects through supply chains and inter-sectoral demand relationships. In the context of East Kalimantan, the weakening of the mining sector has the potential to affect the transportation and warehousing, trade, business services, construction, and other supporting sectors—both through a decline in demand for inputs and through changes in final demand, such as investment and exports.

Given these conditions, an analytical approach is needed that can capture the structure of inter-sectoral linkages and measure both the direct and indirect impacts of changes in key sectors on the regional economy. In this regard, the Input–Output (I–O) table approach, as developed by Leontief (1986), provides a relevant framework for analyzing inter-sectoral relationships systematically and quantitatively. Therefore, this study was designed to understand the structural dynamics of East Kalimantan's economy through Input–Output analysis, as well as to identify which sectors are structurally strongly interconnected and possess greater potential to support real GRDP and employment when changes in economic activity occur. Consequently, the study's findings are expected to provide an objective, evidence-based analytical foundation for understanding the consequences of economic transition and for supporting regional development planning in East Kalimantan.

Based on the development of East Kalimantan's economic structure and performance in recent years, particularly in 2025, the following key issues can be identified: (1) East Kalimantan's economy is highly

dependent on the Mining and Quarrying sector, as reflected by the sector's significant contribution to real GRDP (at constant prices), meaning that changes in the mining sector's performance have the potential to have a widespread impact on the regional economy; (2) Signs of a sustained weakening in the mining sector in 2025, as indicated by the contraction in the growth of the Mining and Quarrying sector over several consecutive quarters; (3) The lack of comprehensive information regarding the ripple effects of the mining sector's decline on other sectors—both direct and indirect—particularly in terms of output, real GRDP, and employment opportunities; (4) The limitations of sectoral macroeconomic statistical analysis (GRDP) in explaining inter-sectoral linkages, making it unable to depict the structure of economic relationships that form the basis for formulating targeted economic transition policies; and (5) The failure to identify the sectors that structurally have the greatest potential to play a role in economic activity, both in terms of value added and labor absorption.

Based on the background described above, the research questions to be addressed by the author in this study are as follows: (1) What are the interdependence effects, and to what extent does the mining sector depend on inputs from other sectors (backward linkages) or serve as an input for other sectors (forward linkages); (2) What is the magnitude of the multiplier effect of the mining and quarrying sector on total output, income, and employment in East Kalimantan? Furthermore, Based on the research questions above ultimately fulfill the objectives of this study, namely: (1) To determine the interdependence effects and the extent to which a sector depends on the output of other sectors (backward linkages) or serves as an input for other sectors (forward linkages); and (2) To determine the magnitude of the multiplier effect of the mining and quarrying sector on total output, income, and employment in East Kalimantan.

Based on the research questions above, the theoretical benefits of this study are to enrich the body of regional economic literature on structural transformation in resource-dependent economies, as well as to provide empirical evidence of the effectiveness of Input-Output (I-O) Analysis in mapping sectoral linkages and simulating the impact of economic shocks on output and employment. Meanwhile, the practical benefits of this study, in order, are expected to strengthen the role of the Regional Office of the Directorate General of Budget (DJPb) as the Regional Chief Economist (RCE) in preparing a more incisive and evidence-based Regional Fiscal Review (KFR), and to provide a roadmap for local governments in formulating economic diversification strategies, particularly to prioritize investment in non-mining sectors with high multiplier effects.

Method

This study is a quantitative study employing descriptive and analytical approaches. The quantitative approach is used to systematically and measurably analyze the economic structure of East Kalimantan, particularly in examining inter-sectoral linkages and the impact of changes in economic activity on output and employment opportunities. The descriptive approach is used to describe the conditions and characteristics of the regional economic structure, while the analytical approach is used to examine sectoral impacts and interrelationships through the Input–Output (I-O) Table model. This model enables the analysis of direct and indirect impacts of changes in one sector on other sectors within the regional economy. Scope and Timeframe of the Study:

1. Unit of Analysis: The economy of East Kalimantan Province, with economic sectors aggregated into 17 industries according to the GRDP classification and the Input–Output Table.
2. Scope of the Study: This study is limited to an analysis of inter-sectoral linkages, output multipliers, and employment opportunities. All analyses were conducted using current prices (ADHB).

3. Time Period: The base Input–Output Table used is derived from Table I O of East Kalimantan for 2016, which was subsequently adjusted to represent economic conditions in 2025 using the RAS method. GRDP and employment data used as controls and for the analytical context cover the period 2024–2025. The operational definitions of the variables in this study are explained as presented in the table below.

Table 1. Operational Definitions of Variables

Variable	Operational Definition	Unit
Sectoral Output	The total value of goods and services produced by each economic sector during a given analysis period, calculated based on the 2024-adjusted Input–Output Table.	Rupiah
GRDP (Value Added)	The contribution of each sector's value added to the regional economy, measured at constant prices, is used to assess the impact of sectoral changes on regional revenue.	Rupiah
Labor Force	The number of employed persons in each economic sector, used to derive labor coefficients and calculate the impact of changes in output on employment.	People
Input Coefficients	The ratio of inter-sectoral inputs to total sector output, which reflects the technical relationships of production in the Input–Output Table.	Ratio
Output Multiplier	The magnitude of the increase in total economic output resulting from a one-unit change in final demand in a given sector.	Ratio
Employment Multiplier	The increase in employment resulting from a one-unit change in final demand in a sector.	People per unit of output

In this study, the analysis method used is Input–Output (I–O) analysis with a demand-driven Leontief model. Data analysis was conducted through the following stages:

1. Compilation of the 2025 Input–Output Table
The 2016 Input–Output Table for East Kalimantan Province was used as the baseline table, which was then adjusted to reflect economic conditions in 2025 using the RAS method. The adjustment was performed by calibrating the inter-sectoral transaction matrices to ensure consistency with total sectoral output based on 2010 ADHB GRDP data across 17 economic sectors for the year 2025. This adjusted Input–Output Table serves as the basis for all subsequent analyses.
2. Calculation of the Input Coefficient Matrix and the Leontief Inverse Matrix
Based on the adjusted 2025 Input–Output Table, a direct input coefficient matrix (A) was compiled, which illustrates the inter-sectoral input requirements per unit of output. Next, the Leontief inverse matrix was calculated, which is used to analyze inter-sectoral linkages and the impact of changes in final demand on total economic output.
3. Analysis of Inter-Sectoral Linkages (Backward and Forward Linkages)
To identify the structural role of each sector in the East Kalimantan economy, backward and forward linkage analyses were conducted.

- a. Backward Linkage is used to measure the extent to which a sector drives demand for inputs from other sectors when its output increases. A high Backward Linkage value (>1) indicates that the sector has strong backward linkages and has the potential to generate widespread ripple effects across supplier sectors.
- b. Forward Linkage is used to measure the extent to which a sector's output is used as an input by other sectors. A high Forward Linkage value (>1) indicates that the sector plays a crucial role as a provider of inputs to other sectors in the economy.

This analysis is used to identify key sectors that have strong structural linkages within the economy, without designating any leading sectors at the outset of the study.

4. Analysis of Output, Income, and Employment Multipliers

The output multiplier is calculated based on the Leontief inverse matrix to measure the total impact of a change in a sector's final demand on the economy's output. Furthermore, the income multiplier (GRDP) is calculated by linking the output multiplier to the sectoral value-added coefficient, while the employment multiplier is calculated by linking the output multiplier to each sector's labor coefficient. This multiplier analysis is used to assess the magnitude of sectoral economic impacts, both in terms of value-added and labor absorption.

5. Interpretation and Synthesis of Analysis Results

The results of the sectoral interdependence analysis (backward and forward linkages) and economic multipliers are used to identify the structural characteristics of East Kalimantan's economy and the sectors that show the potential to play a significant role in responding to indications of economic transition.

Results and Discussion

Overview of East Kalimantan's Economic Structure

The economy of East Kalimantan during the 2022–2025 period indicates that regional economic activity remains on an expansionary trajectory, although the growth rate began to moderate in the most recent year. Based on GRDP data at 2010 constant prices, East Kalimantan's GRDP increased from Rp506.16 trillion in 2022 to Rp537.63 trillion in 2023, then rose again to Rp570.82 trillion in 2024, and reached Rp596.66 trillion in 2025. In line with this, East Kalimantan's economic growth stood at 4.48 percent in 2022, increased to 6.22 percent in 2023, slowed slightly to 6.17 percent in 2024, and declined again to 4.53 percent in 2025. This pattern indicates that, overall, the regional economy continues to grow positively, but its growth momentum in 2025 will not be as strong as in the two preceding years (BPS East Kalimantan, 2026).

In terms of economic structure, East Kalimantan will continue to be heavily supported by the Mining and Quarrying sector through 2025. Based on the distribution of GRDP at current prices by industry, the mining sector's share stood at 35.37 percent in the first quarter of 2025, then declined to 34.17 percent in the second quarter of 2025 and 33.29 percent in the third quarter of 2025, before rising slightly to 33.92 percent in the fourth quarter of 2025 (). On an annual basis, this sector still accounts for 34.18 percent of East Kalimantan's total GRDP, thus remaining the economic sector with the largest contribution to the regional economic structure (BPS Kaltim, 2026).

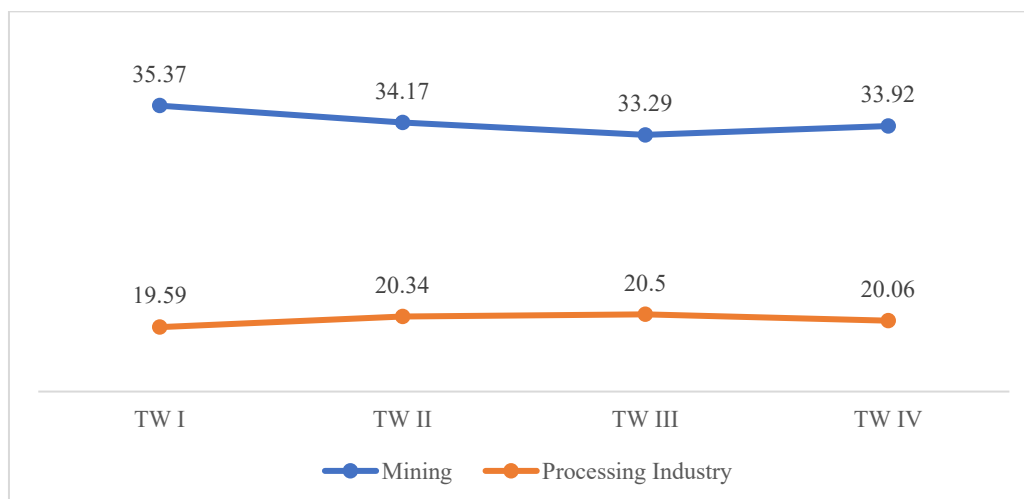


Figure 2. Contribution of Mining and Manufacturing in 2025
Source: East Kalimantan BPS, processed.

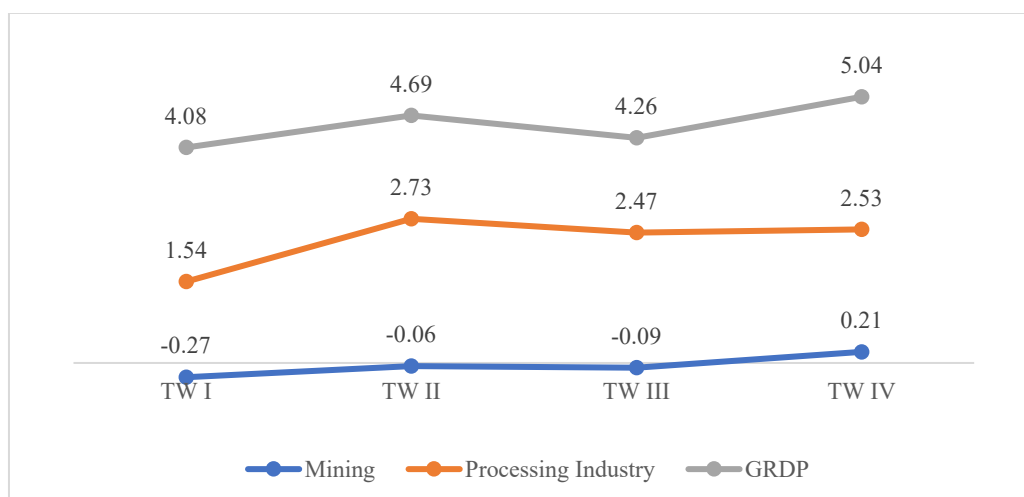


Figure 1. GRDP Growth
Source: East Kalimantan BPS, processed.

At the same time, the Manufacturing sector is also playing an increasingly important role in East Kalimantan's economy. The manufacturing sector's share stood at 19.59 percent in the first quarter of 2025, rising to 20.34 percent in the second quarter of 2025 and 20.50 percent in the third quarter of 2025, before declining slightly to 20.06 percent in the fourth quarter of 2025. On an annual basis, the manufacturing sector's contribution reached 20.12 percent, making it the second-largest sector after mining. Thus, although East Kalimantan's economic structure remains dominated by the extractive sector, the manufacturing sector has contributed approximately one-fifth of the region's total GRDP and has shown a strengthening trend compared to the beginning of the year (BPS East Kalimantan, 2026).

Quarterly developments throughout 2025 show that, amid a moderation in regional economic growth, there has been a shift in the sources of growth across sectors. Overall, East Kalimantan's economy grew by 4.08 percent in the first quarter of 2025, 4.69 percent in the second quarter of 2025, 4.26 percent in the third quarter of 2025, and 5.04 percent in the fourth quarter of 2025, with an annual growth rate of 4.53 percent (BPS Kaltim, 2025; BPS East Kalimantan, 2026). At the same time, the contribution of the Mining and Quarrying sector to economic growth was negative in the first three quarters of 2025, at -0.27 in the first

quarter, -0.06 in the second quarter, and -0.09 in the third quarter, with an annual contribution of -0.05. In contrast, the Manufacturing sector emerged as one of the main drivers of growth, with a growth contribution of 1.54 in the first quarter, rising to 2.73 in the second quarter, 2.47 in the third quarter, and 2.53 in the fourth quarter—or 2.32 on a year-over-year basis (BPS Kaltim, 2026). In fact, according to the BPS's quarterly reports, the manufacturing sector was recorded as the business sector with the highest growth in the second quarter of 2025 at 15.12 percent and in the third quarter of 2025 at 13.96 percent, thereby emerging as the primary driver of growth as the mining sector weakened (BPS East Kalimantan, 2025). These findings indicate that East Kalimantan's economy in 2025 still relies heavily on the mining sector, but at the same time, the manufacturing industry is beginning to play an increasingly significant role as a growth driver.

Input-Output Analysis of the Mining and Quarrying Sector in East Kalimantan Province

The input-output analysis of the Mining and Quarrying sector aims to measure the extent of this sector's contribution and interconnections with East Kalimantan's economy, through output, income, and labor multiplier effects. The mining and quarrying sector plays a strategic role as a foundational sector and the primary contributor to East Kalimantan's Regional Gross Domestic Product (PDRB). However, its capital-intensive nature means its impact on employment and the equitable distribution of community welfare is relatively limited. Therefore, input-output analysis is essential for assessing the extent to which the mining and quarrying sector can drive regional economic growth while supporting sustainable community welfare (Simanjuntak & Anggara, 2022; Wahyuningsih, 2019). The results of the analysis regarding backward linkages and forward linkages in the mining and quarrying sector in East Kalimantan Province are presented in the table below.

Table 2. Backward and Forward Linkages

Sector	Direct Forward Linkage (FL)	Direct Backward Linkage (BL)	Indirect Forward Linkage (IFL)	Indirect Backward Linkage (IBL)
Mining and Quarrying	2.7086	1.4138	1.7501	0.9135

Source: Input-Output (IO) Analysis, Processed

These findings indicate that East Kalimantan's economy in 2025 will still rely heavily on the mining sector, but at the same time, the manufacturing sector is beginning to play a stronger role in supporting growth. The decline in mining's share from the beginning to the end of the year, coupled with its negative contribution to growth in most quarters, suggests that the dominance of the extractive sector is coming under pressure. Conversely, the increasing share of the manufacturing sector compared to the beginning of the year and its significant contribution to growth show that this sector no longer serves merely as a complement but is beginning to become one of the key drivers in the regional economic structure

Table 3. Details of Backward and Forward Linkages in the Mining Sector

Code	Sector	FL	BL	IFL	IBL
A	Agriculture, Forestry, and Fisheries	0.024	0.016	0.015	0.010
B	Mining and Quarrying	1,159	1,159	0.749	0.749
C	Manufacturing	0.244	0.085	0.158	0.055
D	Electricity and Gas Procurement	0.651	0.002	0.420	0.001

Code	Sector	FL	BL	IFL	IBL
E	Water Supply, Waste Management, Wastewater, and Recycling	0.086	0.000	0.056	0.000
F	Construction	0.103	0.045	0.066	0.029
G	Wholesale and Retail Trade; Repair of Automobiles and Motorcycles	0.048	0.030	0.031	0.019
H	Transportation and Warehousing	0.099	0.045	0.064	0.029
I	Accommodation and Food Services	0.045	0.002	0.029	0.001
J	Information and Communication	0.028	0.007	0.018	0.005
K	Financial Services and Insurance	0.015	0.013	0.010	0.009
L	Real Estate	0.024	0.001	0.016	0.001
MN	Corporate Services	0.039	0.004	0.025	0.002
O	Government Administration, Defense, and Mandatory Social Security	0.036	0.002	0.023	0.001
P	Education Services	0.021	0.001	0.014	0.000
Q	Health Care and Social Services	0.058	0.001	0.038	0.001
RSTU	Other services	0.029	0.001	0.019	0.000

Source: Input-Output (IO) Analysis, Processed

Thus, the developments in 2025 can be interpreted as an early indication of a structural transition in East Kalimantan's economy—namely, a gradual shift from the dominance of the extractive sector toward the strengthening of the manufacturing sector. However, this change is not yet sufficient to be immediately interpreted as a profound structural transformation; therefore, further analysis needs to examine whether the strengthening of the manufacturing sector is truly accompanied by broader intersectoral linkages, the creation of local value added, and greater employment effects through the Input–Output.

Forward Linkage (FL)

The Mining and Quarrying sector has a Forward Linkage value of 2.7086, indicating that this sector is a strategic provider of inputs. This high figure suggests that regional economic growth is highly dependent on the stability of the mining sector, as its output serves as the primary driver (input) for production activities in various other sectors. The figure 2.7086 means that, on average, every one-unit increase in final demand across the entire economy will drive a 2.7086-unit increase in output in the Mining and Quarrying sector to meet the input needs between these sectors. When the economy grows overall, the mining and quarrying sector is driven to grow nearly three times faster due to its role as an input provider. This is particularly true for the processing industry (LNG), the electricity and gas supply sector (coal-fired power plants), and the construction sector (concrete/cement) in East Kalimantan Province.

In I-O analysis, forward linkages are often referred to as the Sensitivity Index. This means that the mining and quarrying sector is highly sensitive to economic changes. If other sectors (such as manufacturing, electricity and gas, or construction) experience an increase in demand, the mining and quarrying sector will feel a very significant pull from that demand. Conversely, if downstream sectors experience a slowdown, the mining and quarrying sector will be the first and hardest hit. This high figure confirms that mining and quarrying products are critically needed as raw materials within the economic structure of the region. Since $2.7086 > 1$, the Mining and Quarrying sector is categorized as a Leading

Sector in terms of forward linkages. This sector has an above-average ability compared to other sectors to distribute its output to other sectors within the economic system.

More specifically, the Mining and Quarrying sector's forward direct linkages of 1.159 indicate that this sector's output is widely used by other sectors as production inputs. The highest linkages are found in the Electricity and Gas Supply sector (0.651) because mining and quarrying activities require large amounts of energy for exploration and production operations. The Manufacturing sector (0.244) also exhibits high interdependence, as mining and quarrying outputs serve as the primary raw materials for downstream industries, particularly the mineral and energy sectors. In the Construction sector (0.103) and the Transportation and Warehousing sector (0.099), high interdependence stems from the need for mining infrastructure development and commodity distribution. Meanwhile, the Wholesale and Retail Trade sector (0.048), the Accommodation and Food Services sector (0.045), and the Business Services sector (0.039) are growing due to increased economic activity in mining regions. These findings are consistent with Suseno et al. (2019), who state that the mining sector has strong downstream linkages to the industrial, energy, and infrastructure sectors—thereby generating a multiplier effect for the surrounding economy.

Backward Linkage (BL)

The value of 1.4138 for the Backward Linkage of the mining and quarrying sector in East Kalimantan is quite significant. Since this value is greater than 1 (> 1), this sector exerts a strong pull on the growth of its supplier sectors, thereby driving growth in upstream sectors. For every Rp1 trillion increase in final demand in the mining and quarrying sector, this sector will trigger an overall increase in output across its various input-supplying sectors (such as heavy equipment services, transportation, fuel, and catering) of Rp1.4138 trillion. This sector requires significant input support from other sectors. If this figure is high, it has a positive impact on the local economy, as it indicates that mining activities generate substantial “spending” in supporting sectors within the region.

In I-O analysis classification, if a sector has a backward linkage greater than 1, then that sector should be prioritized to drive economic growth. By boosting mining production, the government is indirectly “pulling” or stimulating growth in the service, trade, and small-scale industrial sectors that supply those mining companies. The figure 1.4138 is part of the multiplier effect. The value 0.4138 (the difference from 1) represents the value added generated in sectors other than mining and quarrying itself. The larger the number after the decimal point, the broader the ripple effect of prosperity spread to other sectors.

When aggregated by sector, the strongest link is found in the Manufacturing Industry (0.085), which supplies heavy equipment, machinery, fuel, and mining industry supplies. The Construction sector (0.045) plays a role in the construction of mine roads, ports, and production facilities, while Transportation and Warehousing (0.045) supports the mobility of equipment and the distribution of mining products. Wholesale and Retail Trade (0.030) also plays a crucial role in supplying operational goods and spare parts. These linkages indicate that mining and quarrying exert significant demand for inputs from supporting sectors, as explained by Soedomo (2010) regarding the high interdependence between industrial sectors and infrastructure in Indonesia.

Indirect Forward Linkage (IFL)

The value of 1.7501 for the Indirect Forward Linkage (IFL) provides a more complex picture than direct linkages alone. This figure reflects the “snowball effect” or chain reaction through intermediary sectors that occurs in downstream sectors. The figure of 1.7501 indicates the impact created in other sectors

after the mining and quarrying sector supplies its output to direct user sectors. For every one-unit increase in final demand across the entire economic system, the mining and quarrying sector will contribute a total output of 1.7501 units (both directly and through subsequent economic cycles—the chain effect).

Indirect Forward Linkage also illustrates the Induction Effect on the Economy because its value is > 1 ; this indicates that the mining sector in East Kalimantan has a very strong “ripple effect” in driving economic activity in downstream sectors in a layered manner. Coal output does not merely serve as fuel for coal-fired power plants (Direct Linkage); the electricity generated by these plants is then used by the manufacturing industry, hotels, and MSMEs to operate (Indirect Linkage). The figure 1.7501 captures this entire chain of processes. The scale of this raw material supply measures just how vital the mining and quarrying sector is to maintaining the operational continuity of the entire economic web in East Kalimantan. Without this sector, many production chains in other sectors would be disrupted or struggle to operate because they would indirectly lose their source of energy or raw materials.

The Mining and Quarrying sector has a far-reaching influence that extends beyond the boundaries of the industry itself. Disruptions to mining production in East Kalimantan would not only directly impact the energy sector but would also create a domino effect that weakens growth in other service and industrial sectors by 1.75 times the initial impact. An indirect Forward Linkage value of 1.7051 indicates that an increase in mining and quarrying output creates a ripple effect on the growth of other sectors. The greatest impact is seen in Electricity and Gas Supply (0.420), as increased mining production will indirectly drive energy demand. The Manufacturing Industry (0.158) also experiences a significant impact due to increased downstream activities and the processing of mining materials. In addition, the Construction sector (0.066) and the Transportation and Warehousing sector (0.064) also grow due to increased infrastructure development and the need for mining logistics distribution. These findings are consistent with Depari et al. (2023), who showed that the mining sector has a large multiplier effect on the energy sector and other supporting industries.

Indirect Backward Linkage (IBL)

The value of 0.9135 for the Indirect Backward Linkage (IBL) indicates the subsequent impact generated in upstream (supplier) sectors after the direct impact of transactions has occurred. Since this figure is less than 1 (< 1), 0.9135 means that every Rp1 unit increase in final demand in the mining and quarrying sector will trigger a 0.9135-unit increase in total output across the entire chain of input-supplying sectors. This indicates that although the mining and quarrying sector has strong direct linkages to other sectors (Direct Backward Linkage > 1), its impact on the supply chain in East Kalimantan is relatively weak. This is because mining companies purchase services from local firms in East Kalimantan (Direct Impact), but those local firms then source their spare parts, technology, or raw materials from outside the province or from abroad. Consequently, this money does not circulate back within East Kalimantan's economy, thereby diminishing the indirect impact.

These figures indicate that the mining support industry in East Kalimantan does not yet have a deep local supply chain. The mining sector in East Kalimantan primarily functions as a “final buyer.” Sectors that supply mining needs (such as heavy equipment repair shops or construction services) do not yet have strong linkages with other local manufacturing industries to meet their production needs (spare parts). This means that an IBL value of 0.9135 indicates that the mining and quarrying sector in East Kalimantan has relatively weak indirect spillover effects. This suggests that the economic impact of the mining and quarrying sector tends to stop at the primary supplier network and is less capable of creating a deeper ripple

effect within the local supporting industrial structure. Local government policies need to be directed toward strengthening the supply chains among supporting sectors so that economic value-added remains within the East Kalimantan region.

An indirect backward linkage value of 0.9135 indicates that the mining sector generates follow-on demand across various sectors through intersectoral linkages in the economy. The greatest impact is felt in the Manufacturing sector (0.055) due to increased demand for intermediate goods and industrial products. Construction (0.029) and Transportation and Warehousing (0.029) also experienced increased demand due to the need for facility construction and the distribution of mining products. Additionally, the Wholesale and Retail Trade sector (0.019) grew in tandem with rising economic activity and the demand for mining support goods. These conditions indicate that the mining sector serves as a key sector capable of generating a broad multiplier effect on the economic structure of East Kalimantan, as found by Surbakti and Nurhidayati (2025) in their analysis of the economic impact of coal investment in East Kalimantan. An analysis of backward and forward linkages concludes that East Kalimantan exhibits a “ ” enclave economy phenomenon and strong extractive dominance, yet with limited local linkages.

The Impact of Changes in Total Output of the Mining and Quarrying Sector on Changes in Income and Labor Demand in East Kalimantan Province

The impact of changes in the total output of the mining and quarrying sector on changes in income and labor demand in East Kalimantan Province is important to analyze because this sector is a major contributor to the regional economy. In the input-output analysis approach, an increase in mining sector output not only drives an increase in production but also creates a multiplier effect on community income and labor absorption in related sectors.

However, the capital-intensive nature of the mining and quarrying sector means its impact on employment is relatively smaller compared to service- and agriculture-based sectors. Previous research indicates that mining investment and activities in East Kalimantan have significantly boosted regional economic output; however, the distribution of benefits in terms of income and employment remains concentrated in specific sectors (Surbakti & Nurhidayati, 2025; Simanjuntak & Anggara, 2022). Therefore, it is important to analyze the impact of changes in mining output to determine the extent to which this sector can create more inclusive and sustainable economic well-being in East Kalimantan.

The impact of changes in total output from the mining and quarrying sector on changes in labor absorption in East Kalimantan Province

An increase in output of Rp1 billion in each sector in East Kalimantan Province indicates varying labor absorption capacities depending on the characteristics of their production structures. The Agriculture, Forestry, and Fisheries sector is able to absorb approximately 3.25 workers per Rp1 billion of output because this sector remains labor-intensive and heavily relies on local workers for farming, plantation, and fishing activities. This finding is consistent with the research by Wijaya and Purnamadewi (2013), which states that the agricultural sector has a higher labor absorption capacity compared to the mining and quarrying sector in East Kalimantan.

The Mining and Quarrying sector is only able to absorb about 0.40 workers per Rp1 billion of output. This low ratio indicates that the mining and quarrying sector is capital-intensive because it relies more on heavy equipment, technology, and machinery than on human labor. This finding is supported by Surbakti and Nurhidayati (2025), who explain that while the mining sector makes a significant contribution to

economic output, its impact on direct job creation is relatively low. Muhammadiyah (2023) also found that growth in the mining sector does not have a significant effect on labor absorption in East Kalimantan due to the dominant role of capital and technology in its production processes.

The Manufacturing sector has a labor absorption ratio of 0.45 people per Rp1 billion of output. Although this sector still requires operational and technical workers, the development of industrial automation has led to a lower labor absorption rate compared to the services sector. Nababan and Purba (2023) explain that increased efficiency and the use of technology in Indonesia's manufacturing industry have caused labor elasticity to decline further.

The Electricity and Gas Supply sector is able to absorb approximately 2.20 workers per Rp1 billion of output because it requires technical and operational staff for utility networks. Meanwhile, the Water Supply, Waste Management, and Recycling sector has a relatively high ratio of 6.86 workers per Rp1 billion of output due to the continued high reliance on direct labor in public services and environmental management. The Construction sector is able to absorb approximately 0.96 workers per Rp1 billion in output because the use of heavy equipment in infrastructure development reduces the need for manual labor. Conversely, the Wholesale and Retail Trade; Automobile and Motorcycle Repair sector is able to absorb approximately 3.91 workers per Rp1 billion in output because the distribution of goods and repair services still relies heavily on human labor.

Table 4. Impact of changes in total mining sector output on changes in labor absorption in East Kalimantan Province

Code	Sector	Labor	Labor/Output (people/billion)
A	Agriculture, Forestry, and Fisheries	352,381	3.25
B	Mining and Quarrying	168,391	0.40
C	Manufacturing	138,773	0.45
D	Electricity and Gas Supply	10,007	2.20
E	Water Supply, Waste Management, Wastewater, and Recycling	5,526	6.86
F	Construction	147,736	0.96
G	Wholesale and Retail Trade; Repair of Automobiles and Motorcycles	383,988	3.91
H	Transportation and Warehousing	126,036	1.57
I	Accommodation and Food Services	163,467	8.27
J	Information and Communication	13,651	0.68
K	Financial Services and Insurance	21,604	1.08
L	Real Estate	12,898	1.28
MN	Business Services	64,380	20.59
O	Public Administration, Defense, and Mandatory Social Security	121,846	3.95
P	Education Services	118,148	5.43
Q	Health Care and Social Services	40,837	2.78
RSTU	Other Services	86,778	7.90
Total	Total	1,976,447	71.55

Source: Input-Output Analysis, analyzed

The Transportation and Warehousing sector has a ratio of 1.57 workers per Rp1 billion in output because it requires labor for logistics and goods distribution activities. The Accommodation and Food

Services sector has a high ratio of 8.27 workers per Rp1 billion in output, indicating that the tourism, hotel, and restaurant sectors are labor-intensive sectors based on direct service provision. This aligns with Todaro and Smith (2020), who state that the service sector has a higher capacity for labor absorption compared to the extractive and heavy industrial sectors because it is based on direct human service provision.

The Information and Communication sector has a relatively low ratio of 0.68 people per Rp1 billion in output due to the dominance of digital technology and automation. The Financial and Insurance Services sector, at 1.08 people, and the Real Estate sector, at 1.28 people, indicate that technology- and capital-intensive sectors tend to have lower labor absorption capacity compared to traditional service sectors.

The Business Services sector has the highest labor absorption rate at 20.59 people per Rp1 billion in output. This high ratio indicates that the business services sector relies heavily on professional, administrative, security, and other business support staff. Additionally, the Education Services sector (5.43), Health and Social Services (2.78), and Other Services (7.90) also have high labor absorption rates because they are based on public services and direct human interaction. This situation suggests that East Kalimantan's economic transformation toward the service sector and downstream industries has the potential to create more inclusive and sustainable jobs compared to reliance on the mining sector.

Impact of Changes in Total Output of the Mining and Quarrying Sector on Changes in the Welfare Level of Workers in East Kalimantan Province

Table 5 shows that a Rp1 trillion increase in the output of the Mining and Quarrying sector in East Kalimantan Province results in an increase in workers' wages across various economic sectors, measured in rupiah. The values in the Wages/Output column indicate the amount of additional wage income received by workers in each sector as a result of the increase in mining sector output. These results show that the mining sector has a multiplier effect on the distribution of workers' income through inter-sectoral linkages in the economy (Surbakti & Nurhidayati, 2025).

The Agriculture, Forestry, and Fisheries sector experienced a wage increase of Rp32,946.86 when mining sector output increased by Rp1 trillion. This impact arises because increased mining activity also boosts demand for food, household consumption, and logistics needs among communities near mining areas. This finding aligns with the research by Hilmawan et al. (2016), which states that mining activities in East Kalimantan continue to create economic linkages with the primary sector, even though the income benefits are relatively smaller compared to the services and utilities sectors. The Mining and Quarrying sector itself experienced a wage increase of Rp17,266.50 for every Rp1 trillion increase in output. This figure indicates that although the average wage for mining workers is relatively high, the distribution of additional income to the workforce is not particularly significant because the mining sector is capital-intensive and relies more on technology, machinery, and heavy equipment than on human labor. Surbakti and Nurhidayati (2025) explain that coal mining investments in East Kalimantan generate a significant increase in economic output, but their impact on direct labor is relatively limited.

The Manufacturing Sector saw a wage increase of Rp13,437.36 due to increased downstream processing and processing of mining products. This indicates that the manufacturing sector is benefiting from rising demand for raw materials and increased production of mining-derived products. Randa et al. (2025) demonstrate that the mining sector has a strong relationship with the downstream industrial sector and is capable of driving processing activities in East Kalimantan. The Electricity and Gas Supply sector experienced a wage increase of Rp922,279.79 due to rising energy and utility needs in mining operations. A similar trend was observed in the Water Supply, Waste Management, and Recycling sector, which saw

the largest wage increase of Rp5,229,416.10, as mining activities require substantial environmental services, waste management, and public utilities. The significant impact on these two sectors indicates that mining activities are highly dependent on the utilities and environmental services sectors (Surbakti & Nurhidayati, 2025).

The Construction sector experienced a wage increase of Rp25,212.54 due to the expansion of mining infrastructure such as haul roads, ports, stockpiles, and other operational facilities. In the Wholesale and Retail Trade; Automobile and Motorcycle Repair sector, the increase in mining output drove a wage increase of Rp33,319.79 due to increased activity in goods distribution, heavy equipment trade, and repair services for mining operational vehicles (Hilmawan et al., 2016). The Transportation and Warehousing sector experienced a wage increase of Rp51,315.36 due to rising logistics and distribution needs for mining products. Meanwhile, the Accommodation and Food Services sector saw a wage increase of Rp129,026.84 as a result of increased mobility among mining workers and economic activity around mining areas. This indicates that service-based sectors benefit significantly from mining activities through increased public consumption and regional economic mobility. Todaro and Smith (2020) explain that the service sector has a broader capacity for income distribution because it is based on direct service to the public.

Table 5. Impact of changes in total mining sector output on changes in labor wage rates in East Kalimantan Province

Code	Sector	Average Wage	Wages/Output (Thousand Rp/Trillion)
A	Agriculture, Forestry, and Fisheries	Rp3,577,014	Rp32,947
B	Mining and Quarrying	Rp7,247,440	Rp17,266
C	Manufacturing	Rp4,107,961	Rp13,437
D	Electricity and Gas Supply	Rp4,191,265	Rp922,280
E	Water Supply, Waste Management, Wastewater Treatment, and Recycling	Rp4,214,894	Rp5,229,416
F	Construction	Rp3,899,643	Rp25,213
G	Wholesale and Retail Trade; Car and Motorcycle Repair	Rp3,271,271	Rp33,320
H	Transportation and Warehousing	Rp4,118,439	Rp51,315
I	Accommodation and Food Services	Rp2,550,171	Rp129,027
J	Information and Communication	Rp4,768,608	Rp236,423
K	Financial Services and Insurance	Rp5,145,743	Rp256,696
L	Real Estate	Rp5,830,219	Rp577,651
MN	Business Services	Rp4,264,414	Rp1,364,100
O	Government Administration, Defense, and Mandatory Social Security	Rp4,412,822	Rp143,027
P	Education Services	Rp4,022,993	Rp184,943
Q	Health and Social Services	Rp5,527,489	Rp376,174
RSTU	Other Services	Rp2,565,996	Rp233,512

Source: Input-Output Analysis, analyzed

The Information and Communication sector experienced a wage increase of Rp236,423.32 due to the growing demand for digital services, communication, and information technology among mining companies. Additionally, the Financial Services and Insurance sector saw a wage increase of Rp256,696.12

as a result of increased financing activities, financial transactions, and risk protection for the mining industry. The Real Estate sector also saw a wage increase of Rp577,650.72 due to the growing need for property, residential areas, and supporting facilities in mining regions (Randa et al., 2025).

Conclusion

Based on the research findings and discussion, the conclusions are as follows:

1. The Mining and Quarrying sector still plays a dominant role in the economic structure of East Kalimantan. However, the weakening performance of the mining sector in 2025, coupled with the increasing contribution of the Manufacturing sector, indicates the early stages of a structural economic transition in the region from the extractive sector toward the manufacturing sector.
2. The results of the input-output analysis show that the Mining and Quarrying sector has strong forward linkages, as indicated by a Forward Linkage value of 2.7086, as well as backward linkages of 1.4138. This indicates that the mining sector plays a crucial role as a provider of inputs to other sectors while also serving as a user of inputs from supporting sectors.
3. Although it has strong direct linkages, the indirect backward linkage value of 0.9135 indicates that the mining sector's ripple effect on the local supply chain remains relatively limited. This condition suggests a tendency toward an "enclave economy"—that is, the dominance of a large extractive sector that is not yet fully and deeply integrated into the local economic structure.
4. From an employment perspective, the Mining and Quarrying sector has a relatively low labor absorption capacity, at approximately 0.40 people per Rp1 billion of output. This underscores the capital-intensive nature of the mining sector, meaning its contribution to direct job creation is more limited compared to the services, trade, agriculture, and accommodation and food services sectors.
5. In general, the Mining and Quarrying sector remains a strategic sector in East Kalimantan's economy, but it has not yet been fully capable of driving inclusive growth. Therefore, strengthening downstream processing, deepening local supply chains, and developing labor-intensive sectors are crucial for expanding economic benefits for the community.

Based on the research findings, the following policy recommendations can be made:

1. Local governments need to strengthen economic transition policies by leveraging activities and revenues from the mining sector to support the development of productive, non-extractive sectors. Policy efforts should focus on infrastructure development— , logistics connectivity, industrial zones, and the development of local businesses—particularly the strengthening of supporting industries, as well as partnerships between mining companies and SMEs, cooperatives, and local enterprises.
2. Local governments need to promote the development of sectors with high labor absorption capacity, such as business services, trade, agriculture, accommodation and food services, education, and health care. Economic diversification into these sectors is crucial for fostering more inclusive growth.
3. The central government—specifically the Ministry of Finance through the Directorate General of Treasury—can play a role in facilitating access to financing for MSMEs through the People's Business Credit (KUR) and Ultra-Micro Financing (UMi) programs, particularly for local businesses with the potential to enter the mining supply chain, such as logistics service providers, catering services, repair services, spare parts retailers, operational support services, and other supporting businesses. The UMi program is specifically designed for ultra-micro businesses that are not yet eligible for banking services through the KUR.

4. Support from the Ministry of Finance can be channeled through fiscal instruments, transfers to local governments, incentives, and financing for the development of infrastructure supporting downstream processing, industrial zones, and logistics connectivity, with the aim of strengthening downstream processing and resource-based processing industries.
5. Both the central and local governments need to focus on improving the quality of human resources through vocational education, technical training, and workforce certification that align with the needs of the processing industry, mining support services, logistics, construction, energy, and information technology. These efforts are necessary so that more local workers can be absorbed into regional economic activities.

This study has several limitations. First, the input-output approach used is static and therefore cannot capture dynamic changes in technology, prices, productivity, and the behavior of economic actors. Second, the analysis was conducted at the sectoral aggregation level and thus does not describe the differences in the characteristics of mining subsectors in greater detail.

In addition, this study focuses primarily on output, sectoral linkages, income, and labor. Environmental aspects, income inequality, job quality, and the spatial impacts at the district/city level are not yet within the scope of the analysis. Therefore, future research is advised to use a more dynamic approach, such as the Social Accounting Matrix or Computable General Equilibrium, to capture the impact of changes in the mining sector on income distribution, household income, and interregional trade. Future research should also disaggregate the mining and processing industry subsectors so that patterns of economic linkages can be analyzed more accurately.

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