

# The Role of the Mining Sector in Regional Economic Development: A Case Study of East Kutai Regency

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## Abstract

This study examines the role of the mining sector in East Kutai Regency's regional economic development, where mining contributes over 40% to GRDP. An integrated analytical framework combining Input-Output analysis with overlay analysis techniques (Location Quotient, Klassen Typology, and Shift-Share) was employed to comprehensively assess the mining sector's structural position, inter-sectoral linkages, and development impact. The Input-Output analysis utilized East Kalimantan's 2016 table updated via RAS method to generate regency specific coefficients, while overlay analysis employed GRDP statistics for 2014 to 2023 to evaluate spatial concentration and competitive dynamics. Input-Output findings reveal the mining sector exhibits weak backward linkage of 1.0 and forward linkage of 0.95, positioning it in Quadrant III with minimal inter-sectoral integration and limited multiplier effects on the regional production system. Overlay analysis through Location Quotient demonstrates the mining sector's highest comparative advantage at 1.76, indicating strong export orientation and spatial concentration. However, Klassen Typology classifies it in Quadrant IV as a lagging sector with growth coefficient of 0.94 and contribution coefficient of 0.93, reflecting stagnant development performance. Shift-Share analysis within the overlay framework confirms the mining sector's severe competitiveness decline at negative 35,714.67, the worst among seventeen evaluated sectors. The convergent results from Input-Output and overlay analyses indicate the mining sector operates as an extractive enclave with insufficient value-added generation and constrained developmental spillovers. Enhancing the mining sector's developmental role requires strengthening backward and forward linkages through downstream processing facilities, local content requirements, and technology transfer mechanisms to transform the sector from an extractive enclave into an integrated regional growth driver.

**Keywords:** Backward Forward Linkages, Input-Output Analysis, Mining Sector, Overlay Analysis, Regional Development.

## 1. Introduction

Regional economic development is shaped by interactions among sectors that generate value added, drive production, and determine long-term growth trajectories. In resource-rich regions such as East Kutai Regency, the mining sector—particularly coal—has long served as the primary foundation of the local economy. Empirical studies highlight that mining contributes substantially to regional output, employment, and income, reinforcing its strategic position within the regional economic structure [1]. The sector's influence is further strengthened by strong backward and forward linkages, making mining a pivotal driver of activities across the regional production system [2][3]. This structural prominence has positioned mining as the dominant engine of economic development in East Kutai for more than a decade.

However, heavy reliance on extractive industries also introduces inherent risks. Price volatility in global commodity markets, fluctuations in international demand, rising production and regulatory costs, and sustainability pressures all contribute to the sector's vulnerability [4]. Additionally, mining activities often impose environmental externalities that challenge long-term socio-economic resilience [5]. The regional development literature emphasizes that an overdependence on primary sectors can hinder structural transformation and increase the likelihood of stagnation if not accompanied by diversification efforts [6]. These risks underscore the importance of critically assessing the sustainability of mining-led economic growth in regions like East Kutai.

Analysis of time-series Gross Regional Domestic Product (GRDP) data indicates that, although the mining sector remains the largest contributor to East Kutai's economy, its growth has begun to show signs of deceleration in several periods [7][8][9]. Meanwhile, non-mining sectors such as construction, trade, transportation, and information-communication have displayed more stable and competitive growth patterns. This suggests the initial emergence of structural shifts within the regional economy, even though the scale of these sectors remains far below that of mining. A similar trend is observed at the provincial level, where the mining sector's aggregate contribution to



East Kalimantan's GRDP has gradually declined [10][11]. These dynamics reinforce the urgency of evaluating the changing position of mining within the broader development trajectory.

In this context, integrating Input-Output (IO) analysis with regional economic diagnostic tools—namely Location Quotient (LQ), Shift-Share, and Klassen Typology—becomes essential for providing a comprehensive assessment of the mining sector. IO analysis offers insights into sectoral interdependencies and multiplier effects, revealing the systemic importance of mining within the regional economy. Conversely, LQ evaluates whether mining remains a basic sector; Shift-Share identifies its relative competitive performance; and Klassen Typology classifies its contribution-growth characteristics compared to other sectors. Together, these methods provide a multidimensional understanding of the structural strength, competitiveness, and developmental role of the mining sector in East Kutai. Such an integrated approach is crucial for determining whether mining can continue to serve as the principal driver of regional development or whether economic diversification should be prioritized to enhance long-term regional resilience.

The sustainability of mining-dependent development in East Kutai Regency must be evaluated within the framework of green development and environmental governance. The regency confronts critical environmental challenges, including deforestation, land degradation, and biodiversity loss, which are intrinsically linked to intensive extractive activities [12]. The regional proximity to Nusantara as Indonesia's new capital city further amplifies the urgency of integrating sustainable development principles into local economic planning and structural transformation strategies [13]. Consequently, the transition toward a green economy necessitates balancing economic growth with ecological preservation through strategic interventions such as renewable energy investments, strengthened environmental governance frameworks, and the facilitation of economic diversification pathways that enable mining-dependent communities to adopt more sustainable livelihoods, thereby securing the regency's long-term socio-economic and environmental resilience [12][13].

## 2. Methods

This study adopts a quantitative approach to evaluate the role of the mining sector in the economic composition of East Kutai Regency. The analytical framework employed integrates Input-Output (I-O) analysis and Overlay techniques, providing a comprehensive assessment of sectoral interdependencies and regional economic structure. The methodological design enables systematic examination of both inter-sectoral linkages and spatial economic characteristics, facilitating evidence-based policy recommendations for sustainable regional development.

The Input-Output analysis serves as the primary instrument for investigating inter-sectoral relationships, particularly focusing on the mining sector's position within the broader economic system. This technique examines the interdependencies among economic sectors and quantifies the ripple effects generated through production and consumption chains. The I-O framework identifies the mining sector's impact on other sectors through a transaction flow matrix of goods and services, while computing multiplier effects arising from demand fluctuations originating in the mining sector and transmitted to downstream industries. This approach proves particularly valuable for mapping the mining sector's contribution to the overall economic system, revealing both direct production relationships and indirect linkages that may not be immediately apparent through conventional statistical measures. Furthermore, the I-O analysis enables quantification of backward and forward linkages, providing insights into supply chain dependencies and value-added distribution across sectors.

Complementing the I-O analysis, the Overlay technique emphasizes the identification of priority sectors based on location-specific characteristics through the application of statistical and spatial instruments. This analytical approach encompasses three complementary methods: Location Quotient (LQ) for assessing sectoral comparative advantage and export base capacity, Klassen Typology for categorizing sectors according to their growth dynamics and contribution patterns, and Shift-Share Analysis (SS) for decomposing the components of sectoral transformation in the regional economy. The LQ calculation determines whether the mining sector exhibits concentration levels sufficient to serve external markets beyond regional boundaries. Klassen Typology facilitates classification of sectors into quadrants representing advanced, developing, potential, or lagging categories based on their relative growth rates and contributions. Meanwhile, Shift-Share analysis disaggregates regional economic growth into national growth effects, industrial mix effects, and regional competitive effects, thereby isolating the mining sector's competitive position relative to provincial and national benchmarks. Collectively, these overlay techniques facilitate identification of sectors with potential to function as drivers of economic growth at the regional level, while simultaneously revealing structural vulnerabilities that may impede diversification efforts. The integration of I-O and Overlay analyses provides a robust methodological foundation for understanding both the functional relationships and spatial characteristics that define the mining sector's role in regional economic development.

**Table 1.** Input-Output Research Variables

Data	Year	Source
Input-Output Table $17 \times 17$	2016	BPS East Kalimantan Province

**Table 2.** Research Variables for Location Quotient (LQ), Shift-Share (SS), and Klassen Typology

Data	Tahun	Sumber
GRDP at Constant Prices East Kutai Regency	2014 - 2023	BPS East Kutai Regency
GRDP at Constant Prices East Kalimantan Province	2014 - 2023	BPS East Kalimantan Province

The original Input-Output table was consolidated into 17 economic sectors following established sectoral classification principles to facilitate systematic analysis and maintain computational tractability. The aggregation scheme grouped sectors with similar production technologies and input structures, thereby preserving essential economic interdependencies required for multiplier analysis. This 17-sector framework provides sufficient granularity to distinguish key economic activities—particularly the mining sector and its linkages—while ensuring robust estimation of technical coefficients and multiplier effects. Table 3 presents the detailed composition and classification of each aggregated sector.

**Table 3.** Classification of Economic Sectors in the Input-Output Analysis

Sector ID	Sector Name
A	Agriculture, Forestry, and Fisheries
B	Mining and Quarrying
C	Processing Industry
D	Electricity and Gas Procurement
E	Water Procurement, Waste Management, Waste and Recycling
F	Construction
G	Wholesale and Retail Trade; Repair of Cars and Motorcycles
H	Transportation and Warehousing
I	Provision of Accommodation and Drinking Food
J	Information and Communication
K	Financial and Insurance Services
L	Real Estate
M, N	Corporate Services
O	Government Administration, Defense and Compulsory Social Security
P	Education Services
Q	Health Services and Social Activities
R, S, T, U	Other Services

## 2.1. Input Output Analysis

The Input-Output (I-O) model introduced by Wassily Leontief serves as an analytical instrument to examine interdependencies among economic sectors through input-output transaction matrices. This model facilitates the identification of direct, indirect, and total effects of one sector's activities on others, and is applied in calculating backward linkage indices, forward linkage indices, and output multipliers. Although I-O tables are typically provided at the national scale, estimation techniques such as the RAS method can be applied to obtain data at the regional level. Within the framework of regional development, I-O analysis functions as a strategic instrument for understanding economic structural configurations, identifying key sectors, and designing development strategies oriented toward inter-sectoral linkages. The applied I-O model refers to the basic Leontief framework that describes relationships among sectoral output, final consumption, and inter-sectoral input flows. Formulas for output distribution, input composition, and construction of the Leontief inverse matrix are employed as the analytical foundation [14]. Furthermore, backward linkage and forward linkage metrics are calculated using standard formulations in I-O literature [15][16], with technical computation implementation following established procedures [14]. To generate output multiplier values, this study utilizes the Leontief inverse matrix as elaborated in related literature, which enables evaluation of the impact of changes in final demand on aggregate economic output as a whole.

## 2.2. Overlay Analysis

### 2.2.1. Location Quotient

This approach can be applied to determine sectors or commodities possessing competitive advantages in a region [17]. Interpretation of LQ calculation results is divided into three classifications that interpret LQ values as follows:

- If the obtained LQ value is  $> 1$ , it indicates that the mining sector is classified as a basis sector or leading sector
- If the obtained LQ value is  $< 1$ , the mining sector is not included in the category of basis sector or leading sector
- If the obtained LQ value equals 1, the mining sector only functions to fulfill the internal needs of the provincial region and does not yet possess the capacity to export to other regions.

### 2.2.2. Klassen Typology

This analysis is utilized to classify four distinct economic zones or encompasses four quadrants [18]. The four quadrants (Table 4) include:

- Quadrant I indicates sectors categorized as advanced and rapidly growing sectors.
- Quadrant II indicates sectors classified as developing sectors.
- Quadrant III indicates sectors falling into the category of potential sectors.
- Quadrant IV indicates sectors classified as lagging or underdeveloped sectors.

**Table 4.** Klassen Typology Classification of Economic Sectors

Average Sectoral Contribution Rate (K)	Average Sectoral Growth Rate (Y)	
	Y sector I (Reg.) $\geq$ Y sector I (Prov.)	Y sector I (Reg.) $<$ Y sector I (Prov.)
K sector I (Reg.) $\geq$ K sector I (Prov.)	Primary Sector (Quadrant I)	Developing Sector (Quadrant II)
K sector I (Reg.) $<$ K sector I (Prov.)	Potential Sector (Quadrant III)	Lagging Sector (Quadrant IV)

### 2.2.3. Shift-Share Analysis

Shift-Share analysis serves as a diagnostic tool to identify sectors with competitive advantages and growth potential within a specific regional economy [19]. This analytical framework decomposes regional sectoral growth into three distinct components: Proportional Shift (PS), which captures the effect of national sectoral growth patterns; Differential Shift (DS), which measures the competitive performance of regional sectors relative to their national counterparts; and Total Shift (TS or SS), which aggregates these components to provide an overall assessment of sectoral dynamics [20]. The computational framework is expressed through Equations (1), (2), and (3), where PS

quantifies structural effects, DS isolates competitive effects, and SS synthesizes both dimensions. The resulting Shift-Share values are interpreted dichotomously [21]:

- a. sectors exhibiting  $SS \geq 0$  are classified as progressive, indicating superior competitive performance and favorable growth trajectories,
- b. whereas sectors with  $SS < 0$  are categorized as lagging, reflecting suboptimal competitiveness and slower expansion relative to regional averages.

$$PS_{ij} = Y_{ij0}(Y_{it}/Y_{i0} - Y_t/Y_0) \quad (1)$$

$$DS_{ij} = Y_{ij0}(Y_{ijt}/Y_{ij0} - Y_{it}/Y_{i0}) \quad (2)$$

$$SS_{ij} = PS_{ij} + DS_{ij} \quad (3)$$

where  $Y_t$  denotes the reference region's GRDP in the terminal period;  $Y_0$  represents the reference region's GRDP in the base period;  $Y_{it}$  signifies sector- $i$ 's GRDP in the reference region at the terminal period;  $Y_{i0}$  indicates sector- $i$ 's GRDP in the reference region at the base period;  $Y_{ijt}$  represents sector- $i$ 's GRDP in the study region at the terminal period; and  $Y_{ij0}$  denotes sector- $i$ 's GRDP in the study region at the base period.

### 3. Result and Discussion

#### 3.1. Input Output Analysis

The Input-Output (IO) analysis framework employed in this study derives from a methodologically rigorous two-stage procedure that combines temporal updating and spatial disaggregation techniques. The 2016 East Kalimantan Provincial IO table was first updated to 2023 using the RAS (bi-proportional) adjustment method, with 2023 Gross Regional Domestic Product (GRDP) data serving as the primary control totals. This technique, widely recognized in regional economic analysis literature for its capacity to maintain the structural consistency of inter-industry relationships while reflecting temporal changes in economic scale and composition, enables the generation of an updated provincial IO table for 2023. The provincial-level table was subsequently disaggregated to the regency level by applying East Kutai's 2023 sectoral GRDP distribution as locational coefficients, thereby deriving a regency-specific IO table that captures both the structural interdependencies of the broader provincial economy and the distinctive sectoral composition of East Kutai. This integrated updating and disaggregation procedure ensures that the resulting IO coefficients, particularly backward and forward linkage indices, reflect contemporaneous economic conditions while maintaining mathematical consistency with national accounting identities and inter-industry transaction patterns.

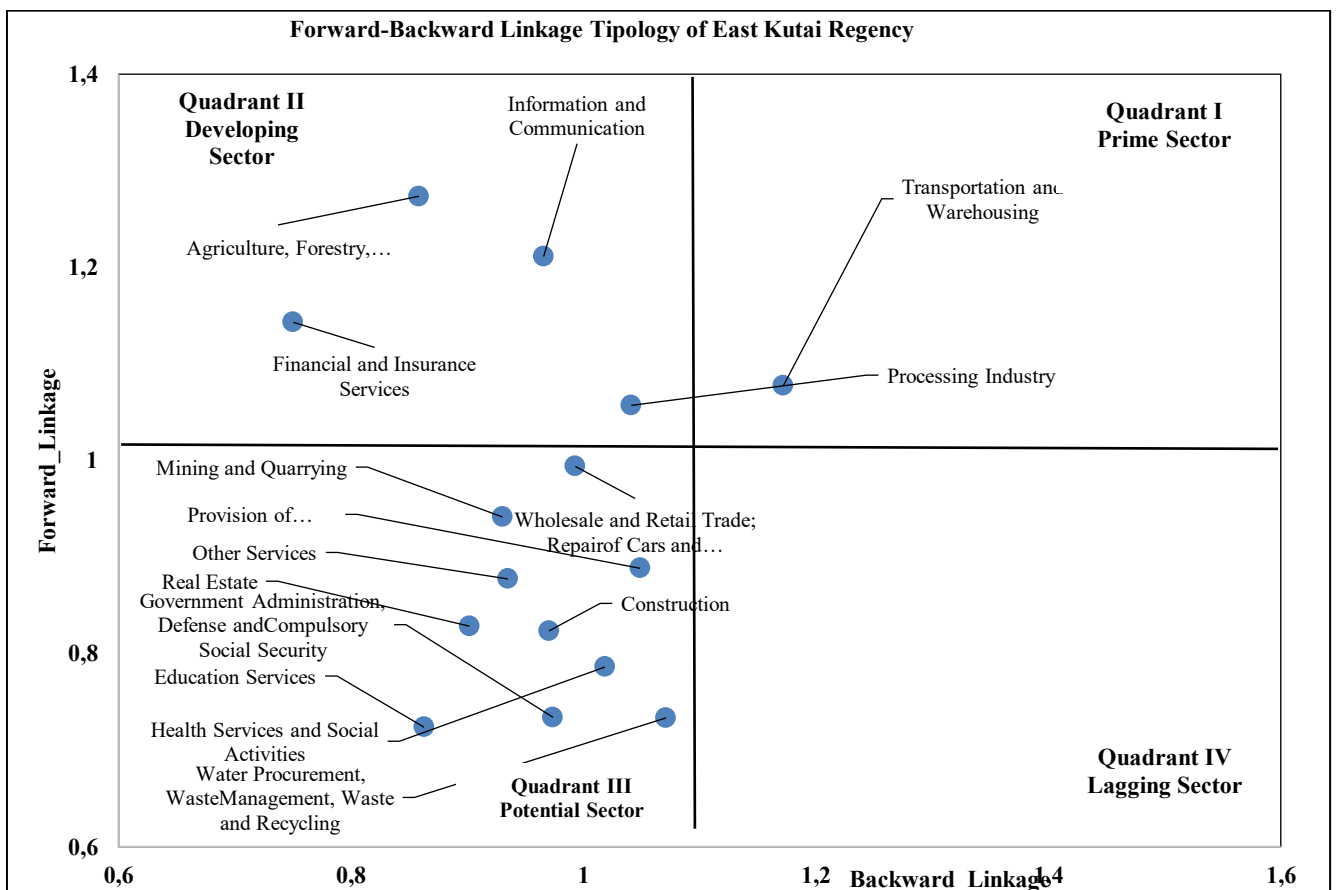
Based on the Input-Output aggregation analysis for East Kutai Regency in 2023, sectoral classification demonstrates heterogeneous distribution in backward and forward linkage perspectives as presented in Table 1 and visualized in Figure 1. The Processing Industry sector, with a backward linkage coefficient of 1.2 and forward linkage of 1.1 as documented in Table 1, along with Transportation and Warehousing demonstrating backward linkage of 1.4 and forward linkage of 1.3 (Table 3), occupy Quadrant I in Figure 1 as key sectors possessing comprehensive multiplier effects on the regional economy. These characteristics confirm both sectors function as multiplicative drivers generating significant ripple effects through inter-industry transactions in creating derived demand and providing intermediate inputs for other sectors' production activities. The positioning of these sectors in Quadrant I signifies their dual capacity to simultaneously stimulate upstream supplier industries through substantial input procurement (backward linkage) and facilitate downstream production activities through provision of essential intermediate goods and services (forward linkage), thereby functioning as critical nodes in the regional production network.

The Mining and Quarrying sector, positioned in Quadrant III in Figure 1 with backward linkage value of 1.0 and forward linkage of 0.95 as indicated in Table 1, reveals a profound structural paradox within the regional economic context. Despite exhibiting the highest Location Quotient (LQ) of 1.7665, which signifies substantial spatial concentration and export orientation, Klassen Typology analysis classifies it as a potential sector characterized by a Growth Rate Coefficient (IFL) of 0.94 and Contribution Coefficient (IBL) of 0.93 (Table 3). The IFL value below unity indicates that the mining sector's growth trajectory in East Kutai Regency systematically underperforms the provincial average, suggesting relatively stagnant growth dynamics despite apparent comparative advantage. The IBL of 0.93 as documented in Table 1 corroborates that this sector's proportional contribution to regency GRDP remains lower than its corresponding provincial-level contribution, despite high sectoral concentration. The combination of threshold backward linkage with below-average forward linkage, as illustrated through the quadrant positioning in Figure 1, reinforces empirical findings of structural limitations in generating regional economic added value, particularly with respect to inter-sectoral linkages with downstream manufacturing activities. The fundamental paradox between mining sector spatial dominance (LQ 1.76) and demonstrably suboptimal performance across IFL (0.94) and IBL (0.93) parameters documented in Table 1, coupled with its Quadrant III positioning (Figure 1) characterized by forward linkage of 0.95, constitutes compelling evidence of an enclave economy phenomenon. Mining output demonstrates a pronounced tendency toward exportation in raw, unprocessed forms with minimal value addition, consequently failing to generate substantive forward linkages to local manufacturing industries as empirically evidenced by the forward linkage coefficient of 0.95 in Table 1 and its relative positioning in Figure 1. The marginally threshold backward linkage coefficient of 1.0 (Table 5) indicates that the majority of operational inputs, including capital equipment, specialized services, and technological inputs, are systematically sourced from external suppliers beyond the regency boundaries, thereby limiting local multiplier effects. Growth stagnation reflected in the IFL coefficient of 0.94 demonstrates a pattern of production expansion that occurs without commensurate increases in local value addition or productivity enhancement, while the IBL of 0.93 confirms that sectoral contribution remains disproportionately modest relative to operational scale and resource extraction volumes. These findings carry significant policy implications for regional development strategy: first, the establishment of downstream mineral processing facilities within the regency to enhance forward linkage coefficients and facilitate the sector's positional migration from Quadrant III toward Quadrant I in the linkage typology diagram; second, the implementation of local content requirements mandating 40 to 60 percent procurement from regional suppliers to strengthen backward linkage intensity; and third, the provision of fiscal and regulatory incentives for vertical integration of mining operations with local manufacturing activities, thereby transforming the sector from an

extractive enclave characterized by minimal inter-industry integration into a comprehensively integrated growth pole capable of elevating both IFL and IBL coefficients through value-added-based growth acceleration and enhanced productivity dynamics.

**Table 5.** Growth Rate and Contribution Coefficients by Sector

SECTOR NAME	Growth Rate Coefficient (IFL)	Contribution Coefficient (IBL)
A.Agriculture, Forestry, and Fisheries	1.27	0.86
B.Mining and Quarrying	0.94	0.93
C.Processing Industry	1.06	1.04
D.Electricity and Gas Procurement	1.47	1.52
E.Water Procurement, WasteManagement, Waste and Recycling	0.73	1.07
F.Construction	0.82	0.97
G.Wholesale and Retail Trade; Repair of Cars and Motorcycles	0.99	0.99
H.Transportation and Warehousing	1.08	1.17
I.Provision of Accommodation andDrinking Food	0.89	1.05
J.Information and Communication	1.21	0.97
K.Financial and Insurance Services	1.14	0.75
L.Real Estate	0.83	0.90
M.N.Corporate Services	1.44	0.99
O.Government Administration, Defense andCompulsory Social Security	0.73	0.97
P.Education Services	0.72	0.86
Q.Health Services and Social Activities	0.79	1.02
R.S.T.U.Other Services	0.88	0.93



**Fig 1.** Typology Forwad Linkage dan Backwad Linkage of East Kutai

### 3.2. Overlay Analysis

#### 3.2.1. Location Quotient

Based on the Location Quotient analysis presented in Table 6, the Mining and Quarrying sector exhibits the highest economic concentration with an LQ value of 1.7665, significantly exceeding the threshold of 1.0 and representing the dominant export-oriented sector in the regional economy. This elevated LQ coefficient indicates that the mining sector produces LQ approximately 76.65% more output per capita

than the national average, signifying a strong comparative advantage and specialization in extractive industries that serve both local consumption and external markets. The sector's substantial concentration suggests the region possesses abundant natural resource endowments and has developed specialized extraction capabilities, including technical expertise, infrastructure, and institutional frameworks that position it as a key supplier within the broader national economic system. This competitive positioning enables the sector to attract external investment, generate export revenues, and serve as a primary driver of regional economic growth through direct employment creation and fiscal contributions.

However, as evident from Table 6, the heavy reliance on mining activities raises critical concerns regarding economic sustainability and structural vulnerability. The concentration in a single extractive industry exposes the regional economy to commodity price volatility, resource depletion risks, and limited inter-sectoral linkages that constrain multiplier effects on downstream industries. The notably low LQ values in Processing Industry (0.1409) and Financial Services (0.1066) suggest insufficient development of value-added manufacturing and supporting business services that could capture greater economic benefits from mining outputs. Therefore, strategic policy interventions should prioritize economic diversification through the development of mineral processing facilities, enhancement of backward-forward linkages with local suppliers, investment in human capital development, and establishment of resource revenue management mechanisms. Such measures would mitigate dependence on primary sector exports while maximizing the transformative potential of mining wealth for sustainable long-term regional development and inter-generational equity.

**Table 6.** Location Quotient (LQ) Calculation Results for East Kutai Regency

CODE	SECTOR NAME	LQ	RESULT
A	Agriculture, Forestry, and Fisheries	0.87	NON BASIS
B	Mining and Quarrying	1.76	BASIS
C	Processing Industry	0.14	NON BASIS
D	Electricity and Gas Procurement	0.22	NON BASIS
E	Water Procurement, Waste Management, Waste and Recycling	0.28	NON BASIS
F	Construction	0.23	NON BASIS
G	Wholesale and Retail Trade; Repair of Cars and Motorcycles	0.33	NON BASIS
H	Transportation and Warehousing	0.31	NON BASIS
I	Provision of Accommodation and Drinking Food	0.26	NON BASIS
J	Information and Communication	0.22	NON BASIS
K	Financial and Insurance Services	0.10	NON BASIS
L	Real Estate	0.41	NON BASIS
M,N	Corporate Services	0.33	NON BASIS
O	Government Administration, Defense and Compulsory Social Security	0.43	NON BASIS
P	Education Services	0.61	NON BASIS
Q	Health Services and Social Activities	0.23	NON BASIS
R,S,T,U	Other Services	0.27	NON BASIS

### 3.2.2. Classen Typology

The application of Klassen Typology to East Kutai Regency's sectoral composition reveals a profound structural metamorphosis in the Mining and Quarrying sector, which despite historically accounting for over 40% of regional Gross Regional Domestic Product (GRDP), now exhibits characteristics that unequivocally exclude it from both prime (Quadrant I) and developing (Quadrant II) classifications. This reclassification is substantiated by two critical indicators: first, the sector's growth trajectory consistently underperforms the provincial benchmark by a margin exceeding 2 to 3 percentage points; and second, its contribution share to the regional economy demonstrates a persistent contractionary trend. In stark contrast, Quadrant I sectors, notably Agriculture, Forestry, and Fisheries, as well as Transportation and Warehousing, simultaneously maintain substantial economic contributions while sustaining robust growth rates that exceed regional averages. Similarly, Quadrant II sectors, exemplified by Construction and Information and Communication, record annual expansion rates surpassing 5%, thereby demonstrating dynamic adaptability and competitive positioning despite relatively modest current contribution levels. The mining sector's inability to achieve either criterion, whether high contribution with positive growth or accelerated expansion trajectories, signals a fundamental loss of both static comparative advantage and dynamic competitive capability.

The comprehensive sectoral analysis presented in Table 7 provides empirical substantiation for the Mining and Quarrying sector's definitive alignment with Quadrant IV characteristics, a classification reserved for sectors exhibiting simultaneous stagnation in growth performance and decline in relative economic significance. As detailed in the table, Mining and Quarrying (sector B) is explicitly positioned within the lagging sector quadrant, where sectoral growth rates fall below provincial benchmarks while average contributions remain comparatively low. This classification carries profound implications when contrasted with the performance trajectories of other sectors: even Quadrant III (Potential) sectors, including Processing Industry (sector C) and Wholesale and Retail Trade (sector G), demonstrate modest yet positive momentum with annual growth increments ranging between 1 and 2 percent, thereby maintaining developmental potential despite lower contribution shares. The mining sector's divergence from this pattern, characterized by negative growth differentials and contracting economic weight, fundamentally repositions it from East Kutai's primary growth engine to a structural impediment that constrains regional economic resilience and adaptive capacity. Furthermore, the sector's placement in Quadrant IV alongside tertiary sectors such as Water Procurement and Waste Management (sector E), Financial and Insurance Services (sector K), and Real Estate (sector L) underscores the severity of its competitive decline, as mining has traditionally been expected to demonstrate higher productivity and growth dynamics compared to these service-oriented activities. These findings underscore the critical necessity for comprehensive policy interventions centered on three strategic axes: first, accelerated economic diversification to cultivate alternative growth poles with sustainable competitive advantages; second, systematic development of downstream mineral processing value chains to capture higher margin industrial segments and enhance sectoral linkages; and third, implementation of innovation driven productivity enhancement programs that facilitate technological upgrading and human capital formation across the regional economic base, thereby mitigating long term vulnerability to resource depletion and commodity price volatility.

**Table 7.** Results of Klassen Typology Analysis for East Kutai Regency

Average Sector Contribution (K)	Sectoral Growth Rate (Y)	
	Y sector I (Regency) $\geq$ Y sector I (Province)	Y sector I (Regency) $<$ Y sector I (Province)
K sector I (Regency) $\geq$ K sector I (Province)	Prime Sector (Quadrant I)	Developing Sector (Quadrant II)
	A. Agriculture, Forestry, and Fisheries	F. Construction
	H. Transportation and Warehousing	J. Information and Communication
	O. Government Administration, Defense and Compulsory Social Security	P. Education Services
		Q. Health Services and Social Activities
K sector I (Regency) $<$ K sector I (Province)	Potential Sector (Quadrant III)	Lagging Sector (Quadrant IV)
	C. Processing Industry	B. Mining and Quarrying
	D. Electricity and Gas Procurement	E. Water Procurement, Waste Management, Waste and Recycling
	G. Wholesale and Retail Trade; Repair of Cars and Motorcycles	K. Financial and Insurance Services
	I. Provision of Accommodation and Drinking Food	L. Real Estate
		M,N. Corporate Services
		R,S,T,U. Other Services

### 3.2.3. Shift-Share Analysis

The competitiveness analysis reveals a critical structural vulnerability in East Kutai Regency's economic architecture, with the Mining and Quarrying sector, historically the cornerstone of regional prosperity, exhibiting the most severe negative competitiveness score (DS = -35,714.673) among all seventeen sectors evaluated. This exceptionally pronounced decline signifies not merely a cyclical downturn, but rather a fundamental erosion of comparative advantage that threatens the long-term viability of the region's extraction-dependent development paradigm. The magnitude of this negative shift reflects the convergence of multiple systemic challenges: progressive depletion of economically viable reserves, persistent volatility in global commodity markets, inadequate technological modernization, and critically, the persistence of a low value-added economic structure characterized by upstream extraction with minimal downstream processing or industrial linkages. These structural deficiencies collectively indicate that East Kutai has reached a critical juncture where the traditional mining-led growth model no longer generates sufficient dynamic externalities to sustain inclusive and resilient economic development. The findings presented in Table 8 provide empirical validation for the urgency of comprehensive economic restructuring in East Kutai Regency. The sector's dramatic underperformance not only undermines current fiscal capacity but also signals deepening vulnerability to external shocks and resource exhaustion scenarios that could precipitate severe socioeconomic dislocation. This evidence necessitates a fundamental recalibration of regional development strategy, pivoting from extractive dependence toward a diversified, innovation-driven economic architecture anchored in three strategic pillars: first, the systematic development of downstream mineral processing industries to capture higher value-added segments; second, the proactive cultivation of alternative competitive sectors with sustainable growth trajectories; and third, the institutionalization of technology transfer mechanisms and human capital development programs that enhance total factor productivity across the economic base. Such transformation requires coordinated policy interventions spanning industrial policy reform, infrastructure investment, regulatory modernization, and strategic partnerships with private sector actors capable of catalyzing technological upgrading and market diversification.

**Table 8.** Results of Shift-Share Analysis for East Kutai Regency

SECTOR NAME	DS	RESULT
A. Agriculture, Forestry, and Fisheries	-5,927.61	Uncompetitive
B. Mining and Quarrying	-35,714.67	Uncompetitive
C. Processing Industry	-11,23.33	Uncompetitive
D. Electricity and Gas Procurement	-2.74	Uncompetitive
E. Water Procurement, Waste Management, Waste and Recycling	-6.03	Uncompetitive
F. Construction	-1,479.43	Uncompetitive
G. Wholesale and Retail Trade; Repair of Cars and Motorcycles	-1,328.38	Uncompetitive
H. Transportation and Warehousing	-1,048.43	Uncompetitive
I. Provision of Accommodation and Drinking Food	-176.07	Uncompetitive
J. Information and Communication	-77.44	Uncompetitive
K. Financial and Insurance Services	-146.89	Uncompetitive
L. Real Estate	-118.03	Uncompetitive
M,N. Corporate Services	-41.26	Uncompetitive
O. Government Administration, Defense and Compulsory Social Security	-557.02	Uncompetitive
P. Education Services	-716.07	Uncompetitive
Q. Health Services and Social Activities	-145.61	Uncompetitive
R,S,T,U. Other Services	-141.84	Uncompetitive

#### 4. Conclusion

This study provides empirical evidence of a fundamental structural transformation in East Kutai Regency's economic architecture, wherein the Mining and Quarrying sector, despite historically constituting the dominant pillar with contributions exceeding 40% of regional GRDP and maintaining the highest Location Quotient of 1.7665, demonstrates systematic erosion across multiple competitiveness dimensions. The integrated analytical framework—comprising Input-Output analysis, Location Quotient, Klassen Typology, and Shift-Share decomposition—reveals that the mining sector exhibits critical structural deficiencies: a Quadrant IV classification in Klassen Typology indicating simultaneous growth stagnation (IFL = 0.94) and declining relative contribution (IBL = 0.93), Quadrant III positioning in linkage analysis reflecting suboptimal backward (1.0) and forward (0.95) integration coefficients, and the most severe negative competitiveness score (DS = -35,714.673) among all seventeen evaluated sectors. These convergent findings substantiate that the sector operates as an extractive enclave characterized by minimal inter-industry integration, external input dependency, and limited value-added generation, thereby constraining regional multiplier effects and economic resilience.

The comprehensive evidence necessitates urgent recalibration of regional development strategy from extraction-dependent paradigms toward diversified, innovation-driven economic architectures. Policy interventions must prioritize three strategic pillars: first, systematic establishment of downstream mineral processing facilities to elevate forward linkage coefficients and facilitate sectoral migration from Quadrant III toward Quadrant I positioning; second, implementation of local content requirements mandating 40 to 60 percent procurement from regional suppliers to strengthen backward linkage intensity and enhance domestic multiplier effects; and third, institutionalization of technology transfer mechanisms and human capital development programs to augment total factor productivity across alternative competitive sectors, particularly Processing Industry and Transportation-Warehousing which demonstrate superior linkage characteristics. These coordinated interventions—spanning industrial policy reform, infrastructure investment, regulatory modernization, and public-private partnerships—constitute essential preconditions for transforming East Kutai from a resource-dependent enclave economy into an integrated, resilient regional growth pole capable of sustaining inclusive development trajectories beyond the exhaustion of finite mineral reserves. Specifically, coal downstreaming through gasification facilities, coal-based chemical industries, and value-added product development (methanol, dimethyl ether, fertilizers) should be prioritized to strengthen forward linkages and capture greater economic rents within the regional production system.

Several methodological limitations warrant acknowledgment. The regency-level Input-Output table represents an estimated construct derived through spatial disaggregation of provincial data, potentially not fully capturing localized transaction patterns unique to East Kutai. The analytical framework depends on a specific base year (2016 updated to 2023) and sectoral aggregation level (17 sectors), potentially constraining temporal generalizability and masking intra-sectoral heterogeneity. The study focuses on economic structural indicators without explicitly modeling environmental externalities (carbon emissions, land degradation, water depletion) or social dimensions (income distribution, poverty dynamics, community welfare) associated with extractive activities. Future research should integrate environmental input-output frameworks and social accounting matrices to evaluate trade-offs between economic efficiency, environmental preservation, and social equity in regional development pathways.

#### References

- [1] “Economic Impact of Coal Mining Investment in East Kalimantan: An Input Output Approach,” *Indonesian Treasury Review Jurnal Perbendaharaan Keuangan Negara dan Kebijakan Publik*, vol. 10, no. 3, pp. 272–284, Sep. 2025, doi: 10.33105/itrev.v10i3.1229.
- [2] B. Zhang, J. Yao, and H. J. Lee, “Economic Impacts and Challenges of Chinese Mining Industry: An Input–Output Analysis,” *Front Energy Res*, vol. 10, May 2022, doi: 10.3389/fenrg.2022.784709.
- [3] X. Liu, J. Shi, and B. Xin, “A New Method for Interindustry Linkage Analysis Based on Demand-Driven and Multisector Input-Output Model and Its Application in China’s Manufacturing and Producer Services,” *Complexity*, vol. 2020, 2020, doi: 10.1155/2020/3857981.
- [4] H. Shang, Y. Kou, F. Su, N. Song, and S. Mao, “The policy effect, spatial heterogeneity, and spillover effect of land system pilots,” *Sustainability (Switzerland)*, vol. 13, no. 21, Nov. 2021, doi: 10.3390/su132111818.
- [5] N. Masood, K. Hudson-Edwards, and A. Farooqi, “True cost of coal: Coal mining industry and its associated environmental impacts on water resource development,” 2020, *Główny Instytut Górnictwa (Central Mining Institute)*. doi: 10.46873/2300-3960.1012.
- [6] M. Yusof Saari, A. Hassan, and M. Daaniyall Abd Rahman, “Evaluation of the relative performance of RAS and cross-entropy techniques for updating input-output tables of Malaysia,” 2014. [Online]. Available: <https://www.researchgate.net/publication/286836404>
- [7] Badan Pusat Statistik, “produk-domestik-regional-bruto-kabupaten-kutai-timur-menurut-lapangan-usaha-2012-2016”.
- [8] Badan Pusat Statistik, “produk-domestik-regional-bruto-kabupaten-kutai-timur-menurut-lapangan-usaha-2015-2019”.
- [9] Badan Pusat Statistik, “produk-domestik-regional-bruto-kabupaten-kutai-timur-menurut--lapangan-usaha-2020-2024”.
- [10] Badan Pusat Statistik, “produk-domestik-regional-bruto-provinsi-kalimantan-timur-menurut-lapangan-usaha-2016-2020”.
- [11] Badan Pusat Statistik, “Produk Domestik Regional Bruto Provinsi Kalimantan Timur Menurut Lapangan Usaha 2011–2015”.
- [12] L. J. Sonter, M. C. Dade, J. E. M. Watson, and R. K. Valenta, “Renewable energy production will exacerbate mining threats to biodiversity,” *Nat Commun*, vol. 11, no. 1, Dec. 2020, doi: 10.1038/s41467-020-17928-5.
- [13] E. B. Barbier, “Greening the Post-pandemic Recovery in the G20,” *Environ Resour Econ (Dordr)*, vol. 76, no. 4, pp. 685–703, Aug. 2020, doi: 10.1007/s10640-020-00437-w.
- [14] R. E. Miller and P. D. Blair, *Input-output analysis: Foundations and extensions, second edition*. Cambridge University Press, 2009. doi: 10.1017/CBO9780511626982.
- [15] R. B. Soares, S. M. O. da Silva, F. de A. de S. Filho, and W. de L. Paiva, “Macroeconomic accounting of water resources: An input-output approach to linkage analysis and impact indicators applied to the state of Ceará, Brazil,” *Water (Switzerland)*, vol. 13, no. 6, Mar. 2021, doi: 10.3390/w13060869.
- [16] M. Muchdie and M. H. Imansyah, “Inter-Sector and Inter-Country Linkages in Indonesian Economy: World Input-Output Analysis,” *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi dan Pembangunan*, vol. 20, no. 2, pp. 232–245, Jan. 2020, doi: 10.23917/jep.v20i2.9057.
- [17] E. Hedayani, “Implementasi Metode Location Quotient (LQ) untuk Analisis Potensi Komoditas Unggulan Subsektor Hortikultura di Kabupaten Muara Enim,” *Geodika: Jurnal Kajian Ilmu dan Pendidikan Geografi*, vol. 6, no. 2, pp. 220–231, Dec. 2022, doi: 10.29408/geodika.v6i2.6496.

- [18] S. Putri Nadia *et al.*, “Analisis Tipologi Klassen Pada Indeks Pembangunan Manusia di Provinsi Bali,” 2023.
- [19] L. Rachmawati, H. Cahyono, J. Nugraha, L. Watjuba, and N. Hanifa, “Shift Share analysis Indonesia masa pandemi Covid-19,” *Jurnal Ekonomi Modernisasi*, vol. 16, no. 3, pp. 165–178, Dec. 2020, doi: 10.21067/jem.v16i3.5042.
- [20] M. Basorudin, N. Afifah, A. Rizqi, M. Yusuf, N. Humairo, and L. M. S. Nugraheni, “ANALISIS LOCATION QUOTIENT DAN SHIFT SHARE SEKTOR PARIWISATA SEBAGAI INDIKATOR LEADING SEKTOR DI INDONESIA,” *ECOBISMA (JURNAL EKONOMI, BISNIS DAN MANAJEMEN)*, vol. 8, no. 1, pp. 89–101, Mar. 2021, doi: 10.36987/ecobi.v8i1.1855.
- [21] D. Adiyatin, N. Satyahadewi, and H. Perdana INTISARI, “ANALISIS OVERLAY UNTUK MENENTUKAN POTENSI SEKTOR EKONOMI UNGGULAN DALAM PEMBANGUNAN DAERAH (Studi Kasus dengan PDRB Kota Pontianak),” 2019.