Mining sector in the economic structure of South Kalimantan Province: direct and indirect impacts

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Abstract. Supporting sectors for sustainable economic development in a region can have a direct impact on GRDP and indirectly have an impact through strong backward and forward linkage to other economic sectors. Analysis of backward and forward linkages can be performed using input-output tables that describe the role of each sector in the regional economy. The abundance of coal resources in South Kalimantan Province makes the mining sector the largest contributor to GRDP. Coal is an export commodity that has a very large percentage of the total regional export value. The enormous impact on GRDP, both in terms of business fields and final demand, is not accompanied by strong linkages to other economic sectors. The existence of the mining sector is unable to stimulate production growth in the backward sector and is unable to fulfill the final demand of the forward sector. Restrictions on coal exports to fulfill domestic energy resource needs are able to make the mining sector of South Kalimantan Province a key sector to support sustainable regional economic development.

1. Introduction

South Kalimantan Province is a region that has an abundance of natural resources so that its economic development also depends on the exploitation of natural resources. The economies that previously favored the agriculture, forestry, and fisheries sectors began to shift towards the mining and quarrying sector, especially coal commodities [1]. With the considerable volatility of coal prices in the global market as an energy commodity, coal remains the leading export commodity in South Kalimantan Province [2, 3]. The rate of coal production is growing rapidly and most of this production is exported in the form of raw material commodities, it is feared that it will not be able to fulfill the demand for coal supply projected in the 2020 National Energy Mix to achieve the target of domestic power plants [4]. The direct contribution of coal commodities to regional income must also be followed by strong linkage to other strategic economic sectors to support the domestic economy's independence further. The "boom" effect of coal resources which is the main support for the economy of South Kalimantan Province through mining activities and exports of raw material commodities needs to be considered so that the “blessing” of coal commodities can be felt for the next generations.

The abundance of natural resources does not cause a "curse", but it depends on how resource management and management of the income generated from these resources are handled. The slowdown in economic growth in countries that depend on the abundance of natural resources is caused by several reasons including the growth in exports of natural resources followed by an expansion of production that is too fast. In addition, other reasons are the high volatility of energy resource prices, miss allocation of income from natural resource exports, corruption, and poor institutional quality [5].
Mining is a local activity that many communities and regions depend on. Mining itself is fundamentally dependent on the existence of natural gifts - mineral deposits. Mining can last sometimes for decades in a community or region through the sustainable development of new mineral reserves during mining. It can persist even after the physical quality of the deposit has decreased (eg, size, quality, metallurgical quality) due to the benefits it provides to society in the form of existing infrastructure and agglomeration economies. However, mineral deposits will eventually run out. Local communities and regions need to plan for this inevitability. Mining has the potential to create significant direct economic benefits in the form of employment and income. It can also generate indirect benefits through linkages with other sectors of the local economy [6].

The economic impact can be seen in: (1) business output (sales volume), (2) economic value added (GDP), (3) individual income (including wages), and (4) employment opportunities. Each of these indicators can be an indicator of the progress of the economic welfare of the population or society, where this indicator is the target of economic development [7].

The input-output model can be thought of as a network in which nodes represent sectors and weighted directional links for input-output transactions between sectors. Integrating input-output models with modern network analysis can provide additional insights to understand the economy's structure better. An economy consists of sectors that depend on each other through the exchange of products and services. Understanding the economy's structure - how the sectors are related to each other - is important for understanding how the system works, because the structure of a system usually determines its function [8].

Based on the input-output table, impact analysis on the economic structure can be carried out. These impacts are looking at the composition of the supply and use of goods and services, knowing which sectors have the most dominant influence on economic growth and which are sensitive to economic growth, estimating the impact of final demand on output, added value, imports, tax revenues, and labor absorption. Finally, the input-output table can be used to construct projections and evaluations of macroeconomic variables. Indicators of economic conditions that can be seen from the input-output table analysis are: 1) the structure of supply and demand for goods and services in a region that can show the role of domestic and import production to fulfill the demand for goods and services, both domestic and foreign (export) demand; and 2) the structure of output, value-added, and final demand to describe the role of each sector in the economy of a region [9]. A simple framework for the table-input output can be seen in table 1 [10].

Through the input-output table, an estimate of the true strength of the relationship between the mining industry and local activities in the form of calculating the backward and forward linkages of mining activities can be known [11]. Research that analyzes the impact of the mining sector on the regional economy structure has been carried out in Indonesia. This study is the impact of the copper mining business on the economy of Papua Province using the analysis of Indonesia's 2010 Input-Output Tables. The impacts analyzed include output, income, and the employment multiplier effect [12].

| Table 1. Simplified input-output tables. |
|----------------------------------------|
| **Final uses** | Final uses | Final uses | Total use by product |
| **Product** | **Agriculture, forestry, etc.** | **Ores and minerals; etc.** | **... Services** | **Exports** | **Total use** |
| **Value-added** | **Value added by component** | **Total supply** | **Total final uses by category** | **Value added** |

| Empty cells by definition |
Other research is about maintaining sustainable development based on the contribution of the export value of crude oil, coal, and natural gas to Gross Domestic Product (GDP) in Indonesia has conducted. It used a multiple linear regression analysis approach, namely the value of petroleum exports has a positive contribution to GDP but is not significant, coal exports have a positive and significant contribution to GDP, and natural gas has an insignificant negative contribution to GDP. These results indicate that Indonesian coal has a comparative and competitive advantage and an opportunity to fulfill different international markets and crude oil, which limits the amount of production to maintain international price stability [13]. Research examining the mining sector's contribution in South Sulawesi Province was carried out using analysis using input-output tables in 2010, classification of 11 economic sectors, and Gross Regional Domestic Product (GRDP) data of 24 districts/cities in South Sulawesi from 2012 to 2016. The analysis was carried out on the output component, trade surplus, export level of mining commodities, multipliers effect, as well as backward and forward linkages [14]. Problems regarding the economic impact caused by the mining sector will of course be different in each country and even provinces within a country. Research on the analysis of the role of the coal mining sector on the economy of South Kalimantan Province has been carried out with results showing the coal mining sector has a high backward linkage value while a lower forward linkage value [15]. There are opportunities to develop linkages in the mining sector, particularly energy resources, where the value of backward linkages may be greater than forward linkages. Based on the experience of high-income countries with a resource-based economic structure, they use outsourcing of input production to support local production to establish a "win-win" linkage [16].

The problem that is examined in this paper is how big the impact of the mining sector's existence is on economic development in South Kalimantan Province. By knowing the economic impact of coal mining on other economic sectors, it is hoped that it can be a consideration for the steps taken in implementing regulations on coal export restrictions. This study describes not only the analysis of the linkage of the mining sector in South Kalimantan Province but also compares it with the contribution of the mining sector to GRDP, its effect on economic growth so that the position of the mining sector in the realm of sustainable regional development can be known.

2. Materials and Methods

Data processing and analysis are divided into two, namely the impact of mining directly and indirectly on the economic structure of South Kalimantan Province. The data used are time-series data from 2010 to 2019, consisting of GRDP at current prices based on business fields and final demand. The business fields are classified into 17 business fields by still referring to the 2015 Indonesian Standard Business Classification [17]. The final demand component consists of household consumption, consumption of non-profit institutions serving households, government consumption, gross domestic fixed capital formation, changes in inventories, and exports of goods and services. The total GRDP based on the final demand must be reduced by the components of imported goods and services [2].

Apart from being based on time series data, quantitative impact analysis also uses the 2010 South Kalimantan Province Input-Output Table [18]. The input-output table used is a matrix consisting of 50 x 50 sectors with an explanation of 9 classifications according to the 2005 Indonesian Standard Business Classification [19]. Adjustments are needed in the classification of business fields so that they can adapt to the 2015 Indonesian Standard Business Classification. The aggregation of the input-output tables is carried out into a 17 x 17 sector matrix. The statistical modeling used in the input-output table is the Leontief Input-Output Model (equation 1) where the effect of changes in final demand is considered an exogenous variable on various economic activities such as output, primary input, imports, and labor.

\[
X = (I - A)^{-1} Y
\]

where: \(X\) is the output vector, \(Y\) is the final demand vector, \(I\) is the identity matrix, \(A\) is the input coefficient matrix, and \((I - A)^{-1}\) is the Leontief inverse matrix.
Leontief inverse matrix can analyze the impact of linkages between production sectors such as backward and forward linkage. The linkage impact can be measured based on the backward linkages effect ratio, which is a measure of the derivative of the backward linkage and the forward linkages effect ratio, which is a derivative of the forward linkage [9]. The components of equation (1) can be derived, used to analyze, for example, if there is a change in investment or exports so that how does it affect output. The results of the derivation of equation (1) can also be used to show the impact on the economy of fulfill additional (final) demand and provide insight into industry-wide effects (direct and indirect effects) [20]. If $l_{ij}$ is the $n \times n$ matrix of the Leontief inverse $(I - A)^{-1}$, then the backward linkage $BL_j$ of sector $j$ can be calculated using the following equation (2):

$$BL_j = \sum_{i=1}^{n} l_{ij}$$

with normalized backward linkage $NBL_j$ from sector $j$ is calculated as follows equation (3):

$$NBL_j = \sum_{i=1}^{n} l_{ij} / \left( \frac{1}{n} \sum_{j=1}^{n} \sum_{i=1}^{n} l_{ij} \right)$$

If $g_{ij}$ is an $n \times n$ matrix of Ghosh inverse $(I - B)^{-1}$, then the forward linkage $FL_i$ of sector $i$ can be calculated using the following equation (4):

$$FL_i = \sum_{j=1}^{n} g_{ij}$$

with normalized backward linkage $NFL_i$ from sector $i$ is calculated as follows equation (5):

$$NFL_i = \sum_{j=1}^{n} g_{ij} / \left( \frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} g_{ij} \right)$$

Key sectors in economic development are sectors that have $NBL > 1$ and $NFL > 1$. Sectors with strong backward linkage have $NBL > 1$ and $NFL < 1$. Sectors that have strong forward linkages have $NBL < 1$ and $NFL > 1$. Sector those that are not a key sector in economic development have $NBL < 1$ and $NFL < 1$ [10].

3. Results and Discussion

3.1. Domination of the mining sector in GRDP
The economic structure of South Kalimantan Province based on GRDP from 2010 to 2019 is dominated by the mining sector (see figure 1) where the dominant subsector is coal and lignite mining (see figure 2). However, the mining sector percentage to the total GRDP of South Kalimantan Province has decreased from 2013 to 29% (2012 contributed 30%) to 2019, which was 19%. This was offset by increased contributions from the processing industry sector and the wholesale and retail trade sector; car and motorcycle repair. The contribution of the processing industry sector in 2011 was 13%, increasing by 2019 to 14% and the contribution of the wholesale and retail trade sector; car and motorcycle repair in 2011 by 7%, increasing until 2019 to 11%. The decline in the mining sector’s contribution to GRDP follows from a decrease in the contribution of coal mining. In 2013 the contribution of coal mining to GRDP was 27% and decreased until 2019 to 17%. The decline in the GRDP contribution of the mining sector is actually in line with changes in the economic structure which became an issue in the text of the 2016-2021 Amendment to the South Kalimantan Regional Medium Term Development Plan. This explains the phenomenon of economic slowdown (see figure 3) which was contributed by the mining sector [21].

3.2. Domination of mineral fuel exports in final demand
Suppose the GRDP is calculated based on the expenditure method. In that case, the final demand component, namely exports of goods and services, has the highest contribution in South Kalimantan Province at 49% per year on average, followed by household consumption expenditure and gross
domestic fixed capital formation (see figure 4). Exports of mineral fuels dominate all exports in South Kalimantan Province with an average contribution of 83% per year (see figure 5). If it is related to the explanation in sub-section 4.1., It can be concluded that having a large export contribution is dominated by coal commodities. With the considerable volatility of coal prices on the world market as an energy commodity, coal remains the largest export commodity in South Kalimantan Province.

![Figure 1. GRDP distribution according to the top five sectors.](image1)

![Figure 2. The distribution of GRDP in the mining and quarrying sector.](image2)
Figure 3.  South Kalimantan Province GRDP growth (based on current prices)

Figure 4.  Final demand for South Kalimantan Province (in million rupiah).
3.3. Linkage of the mining sector to other sectors

The discussion on the direct impact of the mining sector on the economic structure of South Kalimantan Province is presented in sub-section 4.1. and 4.2. namely the dominance of the mining sector's contribution to the GRDP of South Kalimantan Province, especially for coal commodities. Apart from paying attention to the direct impact, an indirect impact analysis is also needed to see whether the contribution of the mining sector also supports other sectors both backward and forward. The strong linkage of a sector to the backward and forward sectors shows that this sector can support sustainable economic development in the region.

Analysis of the linkages in the mining sector using the Input-Output Table of South Kalimantan Province in 2010. The distribution of sectors contribution to GRDP which tends to be the same until 2019 makes the assumption of technical coefficients in the input-output table in 2010 can still be used for linkages analysis in the mining sector in this paper. Linkage analysis uses equation (3) for backward linkage and equation (5) for forward linkage. In figure 6, it can be seen that the backward and forward linkage values for each sector are plotted on a four-quadrant graph where the backward linkage is the x-axis, the forward linkage is the y-axis and the center of the axis is the coordinates (1,1). Quadrant I is a key sector group, quadrant II is a strong forward linkage sector group, quadrant III is not a key sector group, and quadrant IV is a strong backward linkage sector group. In detail, the graph is then translated into table 2.

Based on table 2, it can be interpreted that the key sectors in the economy while supporting the sustainable development of South Kalimantan Province are the processing industry sector and the transportation and warehousing sector. This is because the two sectors use a lot of intermediate input in the form of domestic products from other economic sectors and sell output to fulfill the intermediate input needs of other domestic sectors. Meanwhile, the mining sector is not a key sector in the economy of South Kalimantan Province. When viewed from a backward linkage side, the mining sector of South Kalimantan Province does not use much of the intermediate input product from the domestic sectors so that changes that occur in the final demand of the mining sector are unable to stimulate production growth in all other domestic sectors. When viewed from the side of the forward linkage, the mining sector of South Kalimantan Province cannot fulfill the intermediate input needs of other domestic sectors so that changes that occur in the final demand of the mining sector do not have a significant impact on the output of all other domestic sectors.
Figure 6. Sectors in the linkages quadrants.

Table 2. Economic sectors in the linkage cluster.

| Strong forward linkage                      | Key sector                               |
|---------------------------------------------|------------------------------------------|
| A: Agriculture                              | C: Processing industry                   |
| G: Trade                                    | H: Transportation and Warehousing        |
| K, M, N: Banks and other financial institutions |                                    |
| Not a key sector                            | Strong backward linkage                   |
| B: Mining and excavation                    | D: Electricity and Gas Supply            |
| J: Information and Communication            | E: Water Supply                          |
| O: Government Administration, Defense, and  | F: L: Construction                       |
| Mandatory Social Security                   | I: Supply of accommodation and supply of  |
| P: Education Services                       |   food and drink                          |
| T, U: Activities with no clear boundaries   | Q: Health Services and Social Activities |
|                                            | R: Arts, Entertainment and Recreation    |
|                                            | S: Community and individual services     |

3.4. Discussion

If the impact of the mining sector on the regional economy is only seen from the sector's contribution to total GRDP and the final demand, in this case, is the export component, then the mining sector in South Kalimantan Province will be the most prominent sector. The dependence of a regional economy on sectors with natural resource commodities is commonplace because the utilization of this "abundance" feels easier, especially after extracting, the products of these natural resources can be directly exported as raw material without going through processing to increase the added value of the product. This requires additional investment in infrastructure development and technology capital. Based on this explanation, if applied to the conditions of South Kalimantan Province, the natural resource-based sector in this case is the mining sector with coal export commodities. With higher prices and a larger sales scale, of course, exports are the best option that entrepreneurs in the coal mining sector will choose. In addition, the domestic sector which is the recipient of coal product output in South Kalimantan and Indonesia is still not widely available.
The phenomenon of "Dutch Disease" in a country or region that depends on its economic structure on natural resource-based sectors, especially mining, has now become the focus of experts and researchers in mineral economic management. The question "is mining a curse?" is of interest to examine phenomena in regions with poorly performing mineral economies [6]. When juxtaposed with the condition of economic activity in South Kalimantan Province, several reasons that lead to poor performance can be detected. The addition and expansion of coal production and a surge in coal exports (figure 5) caused the domestic exchange rate to increase, which was followed by an increase in imports in other sectors. Imports of products that occur in other sectors are considered easier and cheaper to fulfill the needs of domestic consumers but have an impact on the development of these sectors (sector shrinkage) so that if the mining sector is no longer able to become a leading sector for export commodities, the region will experience an economic downturn. The surge in exports has made the mining sector and coal commodities have a low linkage value (see figure 6 and table 2) so that they have low long-term economic potential. This wealth of non-renewable resources cannot always be followed by sustainable economic development [22]. Apart from explanations related to internal economic pressures, the weak and inefficient quality of institutions and bureaucracy are the reasons for how this poor performance can occur. The mismanagement of finances obtained from the mining sector is not able to provide real benefits to society, economic development and meaningful social growth can be achieved unless there is a policy change [23].

The results of this study can be used as a reference in regional planning to emphasize strengthening the linkage of the mining sector to other sectors, both backward and forward linkages. This will ensure great potential to accelerate domestic production capacity [24]. The government's policy target is to use coal as a mainstay of national energy supply to minimize the use of petroleum and optimize the use of new and renewable energy following the National Energy General Plan [25]. Optimizing coal in the primary energy mix of at least 30% in 2025 and a minimum of 25% in 2050 should be a reference for South Kalimantan Province to realize a new paradigm that energy resources in this case are coal no longer used as a major export commodity but as a sustainable regional and national development capital.

4. Conclusion
The mining sector for South Kalimantan Province is currently the sector with the largest contribution to total GRDP, namely 25% per year on average (2010-2019). Based on the final demand, the export of coal commodities became the leading export contribution of 83% per year on average (2011-2019). However, this dominance does not make the mining sector a key sector that supports sustainable economic development. It caused to the low linkage of the mining sector to the backward and forward sectors, which is indicated by the backward and forward linkage values of less than one. The existence of the mining sector does not stimulate greater production growth from the backward sector and does not meet the final demand from the forward sector due to the expansion of coal production which is only followed by a surge in the export of these commodities. The National Energy General Plan makes coal a mainstay of the national energy supply. The Province of South Kalimantan should implement restrictions on coal exports to fulfill domestic coal needs as an energy resource to support sustainable regional economic development.

Furthermore, it can be investigated the multipliers effect caused by the mining sector of South Kalimantan Province on other economic sectors on each parameter, namely product output, wages, labor, value-added, and operating surplus, so that the contribution of the mining sector to other economic sectors can be optimized through that parameters.

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