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Article

Sectoral Linkages and Structural Transformation in Indonesia's Agriculture-Based Regions: Evidence from a 34-Province Interregional Input–Output Analysis

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Abstract

This study examines structural transformation and sectoral linkages in Indonesia by analyzing 34 provinces through the 2016 Interregional Input–Output (IRIO) table updated to 2023 using the RAS method. Provinces are categorized into agriculture-based, transforming type A and B, and urban regions by combining agricultural sector contribution and rural poverty levels. The results show that Indonesia remains predominantly in a transforming stage, with only modest shifts over the past decade despite substantial changes in provincial economic structures. Analysis of 1,649 sector–region input units reveals that 10.1 percent hold leading status, although none are from the agricultural sector, indicating shallow upstream and downstream linkages in agriculture. Agricultural-based regions exhibit the lowest productivity and weakest sectoral depth, yet demonstrate the highest marginal GDP multipliers when stimulated, suggesting significant untapped growth potential. A Rp1 trillion increase in final demand generates an average GDP impact of Rp932.5 billion and approximately 128,300 potential jobs, with the strongest labor effects occurring in transforming regions. Interprovincial spillovers remain limited, dominated by intra-regional effects, highlighting fragmented regional integration. Overall, the findings demonstrate that accelerating Indonesia's transformation requires strengthening manufacturing and service linkages around agricultural regions while deepening cross-provincial value chains to reduce persistent spatial inequality.

Keywords: Structural Transformation; Sectoral Linkages; Interregional Input–Output (IRIO); Agriculture-Based Regions; Regional Economic Development.

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I. Introduction

1.1. Background

Indonesia's economic inequality is a serious issue that needs immediate attention due to the significant harm it causes. The direct impact of this problem is economic inefficiency, while the indirect impacts include instability of the social and political order (Todaro & Smith, 2011). Indonesia's diversity of social, economic, and geographical conditions makes the efforts to narrow this inequality more complex. The Williamson Index trend in 34 provinces in the last decade has decreased, but the value is not significant enough. In ten years, the index has only decreased from 0.719 in 2014 to around 0.710 in 2023. This problem of economic inequality is mainly due to the low economic added value in several areas, especially in non-Java areas. The low economic added value is characterized by the dominance of the agricultural sector in the economic structure in these various areas (Figure 1). Nationally, the proportion of the agricultural sector to the GDP is around 12.5% in 2023. In 2023, the agricultural sector accounted for an average distribution of 22% in Sumatra and 20.4% in Eastern Indonesia. This ratio contrasts with the average distribution of this sector in Java and Bali, which is only 10.4%.

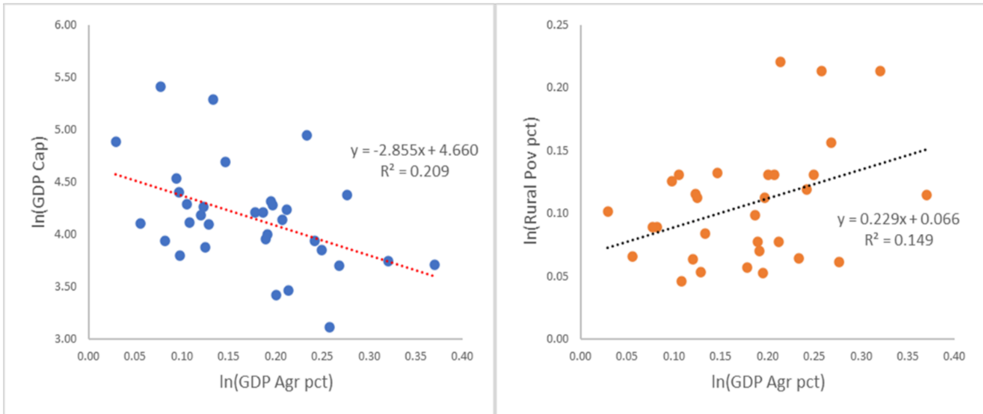

Figure 1: Simulation of Williamson Index Between Provinces in Indonesia 2010-2023

Source: BPS (processed)

Inter-sectoral inequality is also a major issue in the Indonesian economy. In Indonesia, the agricultural sector employs more than half (50.4%), or around 31 million workers. However, the added value generated by this sector is very low compared to other sectors, especially the manufacturing industry sector. Referring to BPS data in 2023, the average GRDP per capita of the agricultural sector was only IDR 83.8 million per capita, while the service sector's value reached IDR 470.7 million per capita. Meanwhile, the manufacturing sector left the other two sectors far behind with a GDP per capita value of IDR 628.9 million. Here the agricultural sector faces a dilemma: on the one hand it is a distributor of economic benefits to many residents, but on the other hand, the added value that it can distribute is very low. The impact is that there is a concentration of poverty, especially in rural areas, where in 2023 the figure reached 54.7% of the total national poor population. Figure 1 shows this dilemma, where there is a positive correlation between the proportion of agricultural sector GDP and the poverty rate in rural areas in various provinces.

This further strengthens the demands for planned (structured) economic transformation so that villagers can enjoy higher added value, without forgetting the aspect of balanced development between rural and urban areas. The 2025–2045 National Long-Term Development Plan has focused on the direction of national regional development to narrow inequality through structured economic transformation (PPN/Bappenas, Rencana Pembangunan Jangka Panjang Nasional (RPJPN) 2025-2045, 2024; PPN/Bappenas, Visi Indonesia 2045, 2018). Evidence-based research, capable of describing the dynamics of inequality from multiple perspectives, is required to support this. Therefore, this study aims to address the gap in research on inequality within the agricultural sector by examining the flow of transactions among economic actors across different sectors and regions.

1.2. Problems, Questions and Research Objectives

The problem raised in this study is the low aggregate economic added value in the region that makes the uncompetitive agricultural sector its main economic driver. So, it is necessary to locate alternative sources of new growth that are competitive in both sectoral and spatial aspects as a replacement. Based on this, it is necessary to carry out mapping by answering the following questions:

(1) How is the production pattern in agricultural-based areas compared to other areas?

(2) How big is the sectoral and spatial relationship between agricultural-based areas and non-agricultural areas?

(3) How is the distribution of leading products from agricultural-based areas compared to other areas?

(4) How big is the economic potential for developing agricultural-based areas compared to other areas?

II. Literature Review

Analysis of structural transformation generally focuses on the concept of transitioning from an agricultural economy to a manufacturing economy (Syrquin, 2008). This perspective is applied to various dimensions, such as the sectoral composition of the GDP structure, the sequence between times during the transformation process, and the sources of financing for capital accumulation (Thaiprasert, 2006). Studies on structural transformation will generally touch on the problem of low productivity of added value in the agricultural sector and the efforts that will be taken to overcome this problem. This is certainly very relevant to the economic situation in Indonesia, which has a dominant proportion of the aggregate agricultural sector but very low productivity.

The situation of low added value and concentration of poverty in rural areas is a common phenomenon in countries that still rely on agriculture for the livelihood of most of their people (Byerlee, Janvry, Klytchnikova, Sadoulet, & Townsend, 2008). This is as discussed in the World Development Report 2008 published by the World Bank. In its report, the World Bank classifies various countries into three categories according to indicators of rural poverty levels and the contribution of the agricultural sector to economic growth. These categories include (1) agriculture-based countries, (2) transforming countries, and (3) urban countries. Countries that fall into the agriculture-based category are characterized by high rural poverty rates and high contributions from the agricultural sector to economic growth. In countries in the transforming category, the agricultural sector is starting to be replaced by other sectors, although rural poverty rates are still relatively high. Meanwhile, the Urban Country category is characterized by low rural poverty rates and the contribution of the agricultural sector to economic growth.

The report categorizes Indonesia as a country in transformation, transitioning from an agricultural-based economy to an urban economy. As a country in transformation, the challenges faced by Indonesia (and other similar countries) are related to demographic pressures and shrinking agricultural land, water scarcity, the existence of underdeveloped areas, and challenges arising from local politics (Byerlee, Janvry, Klytchnikova, Sadoulet, & Townsend, 2008). To face these challenges, the World Bank suggests several development policy objectives that need to be implemented in Indonesia, including the development of high-value activities (non-subsidized) to offset changes in prices and consumption patterns, mapping of pockets of staple food production and leading commodities, the results of which aim to increase the income of the poor, encouraging the provision of non-agricultural jobs (off-farm) to accommodate potential workers who move to rapidly growing economic sectors, and providing infrastructure that supports these various development orientations (Byerlee, Janvry, Klytchnikova, Sadoulet, & Townsend, 2008). The suggested development goals are different from the suggestions for countries in other categories, where in agricultural-based countries the suggested goals are more focused on utilizing agricultural and village commodities to drive national growth, while in urban countries the suggested goals are for developing non-agricultural sectors that are oriented towards urban life.

Measured economic transformation efforts need to consider sectoral and regional linkages. In fact, high economic growth rates can illustrate the achievement of transformation in simple/linear terms. As described in the Harrod-Domar model, high growth is an interaction between high savings rates and efficient production methods (Todaro & Smith, 2011). Such an outcome can also be translated as a combination of good management of economic policies on the consumption side and strong encouragement of technology utilization on the production side. We can perform a partial linear analysis of technology utilization. Sectorally, research (Chen, Ma, Che, & Dou, 2020) tries to calculate the quality of technology through the Total Factor Productivity (TFP) indicator conducted in the Ganzu sub-province, China. The results of the calculation show a fluctuating agricultural TFP value and form a U-shaped curve, while areas with high TFP values expand from the central region to the western region and then to all regions in the province. The results of this estimation provide a method to determine the stage of transformation in the sub-provinces within the Ganzu region (Chen, Ma, Che, & Dou, 2020). Of course, there are many phenomena that also need to be considered in the transformation process. In the case of provinces in Indonesia, for example, there is a tendency for Baumol's Cost Disease to emerge in non-food consumption, which slows down the agricultural transformation process (Abduh, 2023).

Transformation efforts that pay attention to sectoral and regional aspects aim to create a balanced development pattern so that the transformation carried out can be carried out sustainably (Rustiadi, Saefulhakim, & Panuju, 2011; Sukirno, 2006). Failure to create balanced development can result in economic and social losses. The phenomenon of backwashing resources in rural areas to serve cities has widened the gap between the two (Rustiadi, Saefulhakim, & Panuju, 2011). Weak infrastructure supporting connectivity and others (electricity, communication, education, and health) has resulted in the loss of opportunities to balance development in a region (Arifin, et al., 2024). The impact can be seen in the phenomenon of uncontrolled urbanization (both physical and administrative), conversion of village land, hampered regeneration of farmers, the proliferation of informal workers in urban areas, increasing prices and scarcity of goods in rural areas, poverty, and environmental damage in villages and cities. Balanced development should be able to deliver on its goals, which include increased growth, strengthened income distribution, and freedom to determine economic decisions for its citizens (Todaro & Smith, 2011).

One common method used to analyze regional and sectoral economic balance is to use the Interregional Input-Output (IRIO) matrix data, which is a development of the basic Input-Output (IO) matrix. As the name implies, this matrix stores information about the flow of purchases (input) and sales (output) from various sectors and regions in an economic system. The use of this model is the answer to the limitations of the aggregate model, which only roughly estimates the direction of growth (Todaro & Smith, 2011). Working with this matrix can provide useful information that directly aids in making production decisions, like evaluating how well a resource is used, understanding the effects of changes in demand, measuring economic connections, choosing key products or sectors, and analyzing market fluctuations (Valentinyi, 2021).

Numerous studies, both domestically and internationally, have analyzed the transformation phenomenon in the agricultural sector, whether they use the IO/IRIO matrix or not. The use of the IO/IRIO matrix for economic transformation studies even extends to measuring environmental impacts. Saban, Sahara, & Falatehan (2023) used the IRIO matrix data from 52 sectors and 34 provinces in Indonesia provided by BPS to study how important it is to develop the agricultural sector for the economy (Saban, Sahara, & Falatehan, 2023). These features include output, intermediate and final demand, intermediate input, and the size of GDP. Meanwhile, Coveri, Paglialunga, & Zanfei (2024) used the IRIO matrix between countries to show how products are connected in terms of production (product-level positioning) and to find out how much value a country gains (functional positioning) from being part of the global value chain (GVCs) (Coveri, Paglialunga, & Zanfei, 2024). The results of this mapping are used to estimate the welfare impact represented by the Gini index on household income. The use of IO/IRIO data is important in isolating upstream and downstream activities that often face discrimination in calculating the impact of trade in general on people's welfare. Thaiprasert (2006), in her dissertation, compared the linkage index and multiplication value between the agricultural sector and other sectors to measure investment feasibility, especially in the value-added agricultural subsector and agro-industry (Thaiprasert, 2006). Meanwhile, Hong, Lee, Tsai, & Tsai (2018) utilized the IO/IRIO matrix to encourage the transformation of the agricultural economic model in Taiwan after the 2007 financial crisis, which had an impact on increasing the multiplication of greenhouse gases (CO_2) (Hong, Lee, Tsai, & Tsai, 2018).

The main obstacle to using the IO/IRIO matrix is the limited data available in a short period of time (Nazara, 2005; BPS, 1999). This situation has sparked a debate regarding the feasibility of employing linear analysis with outdated matrices (Zhu, et al., 2022; Margarian, 2024; Nazara, 2005; Daryanto & Hafizrianda, 2013; Rustiadi, Saefulhakim, & Panuju, 2011).

One solution to overcome this issue is to update the analysis by using a previous technology matrix, which eliminates the need for a detailed survey to obtain the current technology matrix. Nazara, 2005; Daryanto & Hafizrianda, 2013 refer to this method as the RAS method. The goal of estimating the intermediate input matrix with the RAS method is to reflect the changing market interactions in different sectors and regions. Previous studies have shown that there is a regular error in predicting both future and past data when only using technology coefficient information from unchanging intermediate output matrices (Kurniawan & Kristiarini, 2022). We expect the use of this IO/IRIO matrix to enable a more comprehensive study of the phenomenon of structural transformation, particularly from the agricultural side.

III. Method

3.1. Data Sources

Some of the data used in this study and their explanations are as follows:

- Interregional Input-Output (IRIO) Data 2016
  - This data is the main data of this study. The type of data used is based on domestic basic prices consisting of 52 subsectors. This data is issued by BPS.
- GRDP Data for Business Fields 2014-2023
  - This data is used to update the 2016 IRIO Matrix to 2023 using the RAS method. Specifically, the GRDP data for the agricultural sector, together with poverty rate data, will be used to classify provinces into regions according to their agricultural transformation. We will use data based on current prices by province in 2023, encompassing 17 sectors. This data is issued by BPS.
- Poverty Rate Data 2014-2023
  - This data is issued by BPS. This is rural poverty rate data, released by BPS. We use this data, along with GRDP data, to categorize provinces into their respective regional groups.
- Provincial Minimum Wage Data for 2023
  - This data is used to calibrate the employment compensation value into the number of jobs. This data is issued by the Directorate General of PHI and JSK, Ministry of Manpower of the Republic of Indonesia[2].

To update the information, the 2016 IRIO data, which has 52 sectors, is combined into 17 sectors and replaced with the newest data from 2023, then divided again based on the original proportions. In some sections, this article also combines the sectors into four categories: agriculture, mining, manufacturing, and services. The use of the three

[2] https://satudata.kemnaker.go.id/data/kumpulan-data/942#:~:text=Satudata%20Kemnaker%20%7C%20Portal%20Data%20Ketenagakerjaan%20RI&text=Nilai%20rata%2Drata%20Upah%20Minimum,UMP%20mencapai%207%2C5%25.

terminologies for these sectors (52, 17, and 4 sectors) is used interchangeably based on the ease of description of the analysis carried out. Where the classification is as follows[3]:

- Agriculture
    - **Agriculture, Forestry, and Fisheries**
        - *Food Crop Farming*
        - *Annual Horticultural Crop Farming, Perennial Horticulture, and Others*
        - *Annual and Perennial Plantations*
        - *Livestock*
        - *Agricultural Services and Hunting*
        - *Forestry and Logging*
        - *Fisheries*
- Mining
    - **Mining and Quarrying**
        - *Oil, Gas, and Geothermal Mining*
        - *Coal and Lignite Mining*
        - *Metal Ore Mining*
        - *Other Mining and Quarrying*
        - *Coal Industry and Oil and Gas Refining*
- Manufacturing
    - **Processing Industry**
        - *Food and Beverage Industry*
        - *Tobacco Processing Industry*
        - *Textile and Apparel Industry*
        - *Leather, Leather Goods, and Footwear Industry Foot*
        - *Wood Industry, Wood and Cork Products, and Woven Products from Bamboo, Rattan, and the Like*
        - *Paper and Paper Products Industry, Printing, and Reproduction of Recorded Media*

[3] Underline is the four sector category; **Bold** is the seventeen sector category; and *italic* is the 52-sector category.

        - *Chemical, Pharmaceutical, and Traditional Medicine Industries*
        - *Rubber, Rubber and Plastic Products Industry*
        - *Non-Metallic Mining Products Industry*
        - *Basic Metal Industry*
        - *Metal Products Industry, Computers, Electronic Goods, Optics and Electrical Equipment*
        - *Machinery and Equipment Industry YTDL*
        - *Transportation Equipment Industry*
        - *Furniture Industry*
    - **Electricity and Gas Supply**
        - *Other Processing Industry, Repair and Installation Services of Machinery and Equipment*
        - *Electricity*
        - *Gas Supply and Ice Production*
    - **Water Supply, Waste Management, Waste and Recycling**
        - *Water Supply, Waste Management, Waste, and Recycling*
    - **Construction**
        - *Construction*
- Services
    - **Wholesale and Retail; Car and Motorcycle Repair**
        - *Car, Motorcycle and Motorcycle Trade and Repair*
        - *Wholesale and Retail Trade, Not Cars and Motorcycles*
    - **Transportation and Warehousing**
        - *Rail Transportation*
        - *Land Transportation*
        - *Sea Transportation*
        - *River, Lake, and Ferry Transportation*
        - *Air Transportation*
        - *Warehousing and Transportation Support Services, Post and Courier*

- **Provision of Accommodation and Food and Beverages**
  - *Provision of Accommodation*
  - *Provision of Food and Beverages*
- **Information and Communication**
  - *Information and Communication Services*
- **Financial and Insurance Services**
  - *Financial Intermediary Services Other Than Central Banks*
  - *Insurance and Pension Funds*
  - *Other Financial Services*
  - *Financial Support Services*
- **Real Estate**
  - *Real Estate*
- **Company Services**
  - *Company Services*
- **Government Administration, Defense, and Compulsory Social Security**
  - *Government Administration, Defense, and Compulsory Social Security*
- **Educational Services**
  - *Educational Services*
- **Health Services and Social Activities**
  - *Health Services and Social Activities*
- **Other Services**
  - *Other Services*

3.2. Methodology

3.2.1 Regional and Sector Categorization

This study classifies regions in Indonesia, at the provincial level, into four categories. The classification refers to the method used by the World Bank in the 2008 World Development Report, with slight modifications [4]. namely: agricultural-based areas, transforming areas (types A and B), and urban areas. The mapping is as follows Table 1.

[4] In the report, the contribution of the agricultural sector is figured out by taking its growth rate and multiplying it by how much the agricultural sector makes up of the total GRDP, then dividing that by the overall GRDP growth

The quadrant's cut-off boundaries of each variable (distribution of the agricultural sector and percentage of rural poverty) are the average values in the last decade (2014-2023). This classification is independent, or not transitive, meaning that one category is not higher than another category.

The determination of categories in the provinces of West Nusa Tenggara, Central Sulawesi, and North Maluku is justified. This is done because in 2023, the three provinces experienced anomalous distribution of sectors in their economic structure (figure 2). The cause of the anomaly in the three provinces is similar: an increase in mining sector production over the last few years in each province has led to a reduced proportion of the agricultural sector. This makes the categorization of areas in these provinces look unrepresentative. To overcome this, data on the distribution of the agricultural sector in certain years was selected with relatively stable figures. In the provinces of NTB and Central Sulawesi, data from 2014 was selected, while data from 2018 was selected for North Maluku province. However, this justification does not affect the categorization of other provinces, especially in terms of determining the cut-off for each variable (rural poverty and proportion of the agricultural sector).

Table 1. Technical Definition of Regional Categorization

% Rural Poverty / % Agriculture Distribution in GDP	The percentage of poverty in rural areas within the province[5] was below the national average. ($\%Pov\_rur_{Prov} < \%Pov\_rur_{Nat}$)	The percentage of poverty in rural areas within the province was above the national average. ($\%Pov\_rur_{Prov} > \%Pov\_rur_{Nat}$)
The percentage of GRDP in the agricultural sector within the province was above the national average. ($\%Agr_{Prov} > \%Agr_{Nat}$)	Quadrant 3: Transforming Areas Type B	Quadrant 1: Agriculture Based Areas
The percentage of GRDP in the agricultural sector within the province was below the national average. ($\%Agr_{Prov} < \%Agr_{Nat}$)	Quadrant 4: Urban Areas	Quadrant 2: Transforming Areas Type A

***Source**: Author Calculation*

rate. In this paper, the contribution is only shown as the share of the agricultural sector in GRDP. In this paper, the contribution variable is only represented by the proportion of the agricultural sector in GRDP.

[5] Percentage of Rural Poverty = Rural Poor / (Rural Poor + Urban Poor)

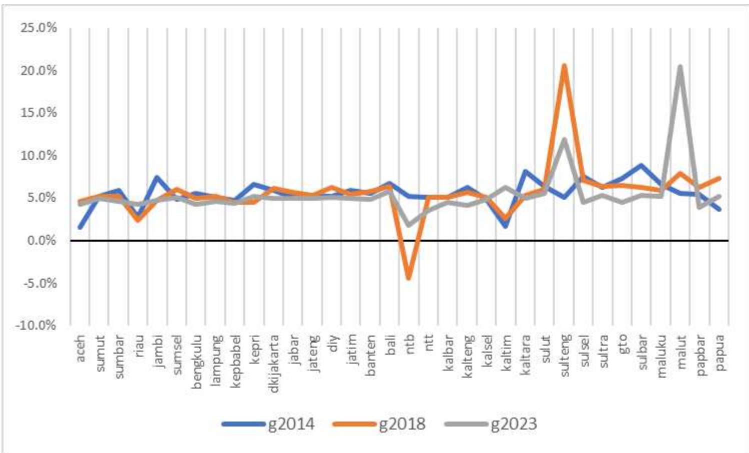

Figure 2: Economic Growth Rate (EGR) of Provinces in Indonesia in 2014, 2018, and 2023

Source: BPS (processed)

3.2.2 Economic Multiplication and Linkages Analysis

The IO/IRIO matrix generally falls into three quadrants. The first quadrant consists of information on intermediate input/output (Z); the second quadrant consists of information on final demand (F), such as household consumption, consumption of non-profit institutions serving households, government expenditure, inventory and gross fixed capital formation, and exports both domestic and abroad. The third quadrant encompasses Total Intermediate Input and Gross Value Added (V). Total Intermediate Input consists of the Foreign Import variable and the Interprovincial Import variable, in addition to the Total Domestic Intermediate Input resulting from the sum of the first quadrant itself. Gross Value Added includes the variables of Labor Compensation, Gross Business Surplus, and Net Tax Subsidies on Production. This gross value added is also considered a representation of the gross regional domestic product (GRDP) of each province. Each quadrant has a different matrix dimension. The first quadrant has dimensions of *nxn*, the second quadrant has dimensions of *nx1* for each variable, while the third quadrant has dimensions of *1xn* for each variable.

3.2.2.1 Leontief Multiplication Matrix

The information in the IO/IRIO matrix can be used for many analytical purposes. One of them is the calculation of the technical coefficient value of each sector/region. This coefficient is the ratio between the input/output components and the total input/output. We denote the technical coefficient as follows:

$$A_j = \frac{z_{ij}}{x_j} \qquad \text{dan} \qquad A_i = \frac{z_j}{x_i}$$

From the equation, it is known that there are two types of coefficient matrices: input coefficient matrix (Aj) and output coefficient matrix (Ai). Input coefficient (Aj) shows how much it costs to use different types of inputs (zi) to make one unit of a specific output (Xj). The greater the input coefficient, the more inefficient the condition is in utilizing the input in question. The opposite condition occurs in the output efficiency matrix (Ai), which describes the amount of intermediate output produced in various production methods (zi) for each utilization of one unit of total input of a certain type (Xi). A higher coefficient value means more efficient input use.

These coefficient matrices will then be used to measure the output and input multiplier coefficients. The technical input coefficient will be used as a component of the output multiplier coefficient, whereas the technical output coefficient will be applied in the input multiplier coefficient. This paper will only utilize the technical input coefficient to produce the output multiplier coefficient, or commonly called the Leontief multiplier coefficient, which is denoted as (1-A)-1. This is explained by the following matrix equation:

$$X = Z + F$$

⇨ $\frac{X}{X} = \frac{Z}{X} + \frac{F}{X}$

⇨ $1 = A + \frac{F}{X}$

⇨ $(1 - A) = \frac{F}{X}$

⇨ $X = (1 - A)^{-1}F$

In the equation, the Leontief multiplier matrix acts as a multiplier for final demand to produce output figures. This means that changes in final demand will affect the output, which can be expressed as follows (Nazara, 2005):

$$\Delta X = (1 - A)^{-1}\Delta F$$

This paper will also look at the impacts caused intra-regionally, inter-regionally, and the total of both. *An analysis of the block diagonal* matrix of inputs between each province yields the intra-regional impact (Li, Gu, & Green, 2020).

3.2.2.2 RAS

From 2016 to 2023, each province carries out the IRIO table updating process on the intermediate input matrix (Z). The RAS method is an abbreviation of R(t) A(t) S(t) (Nazara, 2005). Several vectors needed for the process of updating the Z matrix in 2023 are U (2023), V (2023), and X (2023). Vector U is the sum of each column of the Z matrix in 2023, so its dimension is *n x 1*. Vector V is the sum of each row of the Z matrix in 2023, so its dimension is *1 x n*. Meanwhile, X is the total input or output value in 2023. We obtain the values of the UVX vectors in this paper from proportional estimates using 2023 GRDP data. Similar updating is also carried out on components outside the input, such as variables in final consumption and primary input.

The utilization of 2023 GRDP Data needs to go through a calibration process first from 17 sectors to 52 sectors as described in section 3.1. regarding the Data Source above. This is done by detailing the GRDP data proportionally, by referring to the Gross Value Added (NTB) data in the IRIO matrix. Therefore, a mapping of the sectors in the 2016 NTB data was first carried out into 17 sector groups as in the 2023 GRDP data, before carrying out proportional calibration on it. This is by assuming that the proportion of the sectors in the NTB data does not change over time.

3.2.2.3 Economic Impact

In this paper, the output multiplier coefficient value consists of three types, including the overall multiplier coefficient (L), the intra-provincial multiplier coefficient (L_inti), and the inter-provincial multiplier coefficient (L_inter). The distribution of these coefficients can also be viewed as the result of changes in output that occur due to a change in one unit of final input demand, which corresponds to the diagonal[6] elements of the coefficient matrix. The diagonal elements represent the direct impact of output, while the remaining elements represent the indirect impacts. To study the distribution pattern of the output multiplier coefficient—both L, L_inti, and L_inter—can be seen elementally and aggregately. The elemental impact is here the matrix elements formed from the multiplication of the Leontief coefficient matrix by its identity matrix, while the aggregate is the sum of the elements to determine the value of the direct, indirect, and total impacts.

The assumption in the IO/IRIO matrix analysis is a constant return to scale (Nazara, 2005). This means that the ratio of the matrix components stays the same despite changes. This assumption also impacts equivalent changes in the indicators entered in the input-output system. After calculating the output multiplication value, as explained above, this paper will also calculate the multiplication rate of changes in several economic indicators. These indicators cover GDP, labor compensation and number of jobs, foreign trade (exports and imports), and the additional taxes/subsidies formed.

In short, the calculation of the impact of changes in these variables is the impact of the final demand stimulus (ΔF) on changes in output (ΔX). This change in output serves as a multiplier for the coefficients of economic indicators (v), which will be analyzed for their impact (ΔV).

$$\Delta V = v.\Delta X$$

Where the coefficient is a diagonal form of these indicators.

3.2.2.4 Backward Linkage Index (IKB) and Forward Linkage Index (IKD)

We need an index to measure the level of linkage between one sector and its upstream and downstream sectors. According to Miller & Blair (2009) and Nazara (2005), there are two types of linkage indices for this purpose. The first index is the backward linkage index and the forward linkage index. This index is the ratio between the total technical coefficient of an input/output in a sector and region (ΣA_{ij}) and the average total technical coefficient of all its inputs/outputs ($1/n*\Sigma\Sigma A_{ij}$). However, this paper does not include this index in its analysis. The second measure is the total linkage index, which includes both direct and indirect links, both forward and backward in nature. The calculation concept is like the direct linkage index, but the coefficient used is the Leontief multiplier coefficient $(I\text{-}A)^{-1}$. The calculation of this index is described as follows:

$$Backward\ Linkage\ Index\ (IKB) = \frac{\sum(I - A_i)^{-1}}{\frac{1}{n}\sum\sum(I - A_i)^{-1}}$$

[6] The elements share the same province and sub-sector as their inputs and outputs.

$$Forward\ Linkage\ Index\ (IKD) = \frac{\sum (I - A_j)^{-1}}{\frac{1}{n}\sum\sum (I - A_j)^{-1}}$$

IKB describes how the input of a product and region can cause output multiplication in its economy. While IKD describes the comparison of input multiplication to its economy that can be caused by the production activities of the output of a product and region. If the value of either index (IKB or IKD) exceeds one, it is considered a partial leading index. The sector in a region is said to be leading status when both indexes (IKB & IKD) together are valued above one (Miller & Blair, 2009; Nazara, 2005; BPS, 1999).

In this paper, we will technically divide the use of IKD and IKB information into four categories of leading sector development. The goal is to determine the number of fiscal needs and the impacts caused by intervening in each of these categories. The first category includes sectors that have both forward and backward advantages, meaning these sectors can create a significant multiplication impact by serving as inputs for downstream outputs (forward) and as absorbers of upstream sectors (backward). Second are sectors that have advantages in pushing downstream only, and third are sectors that have advantages in pushing upstream only. The final group comprises sectors that possess neither upstream nor downstream advantages.

Based on the explanation above, the order of processing the IRIO matrix in this paper is as follows:

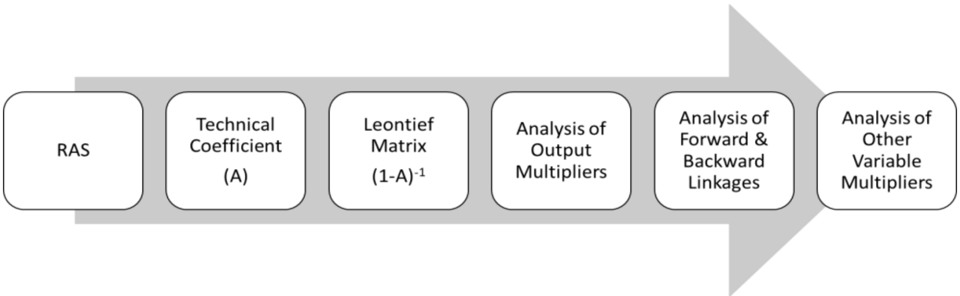

Figure 3: IRIO Matrix Analysis Flow

IV. Results

The classification results based on rural poverty rates and the proportion of the agricultural sector in each province in 2023 produced four regional categories (table 2). Transforming Provinces type B were the largest, or 35.3%, of the total provinces analyzed. When combined with Transforming Provinces type A, the number even reached 44.1% or far surpassed areas with other categories. Meanwhile, the agriculture-based provinces were in last place (if areas transforming provinces types A and B were combined) at 23.5%, after urban provinces (32.4%). The decreasing number of agriculture-based provinces is similar to the findings of the World Bank report in 2008, which categorized Indonesia as a transforming country. What is concerning about these findings is that Indonesia's status at the subnational level has not changed in almost 20 years since the report was issued.

Table 2: The Province's Categories in 2023

Kw 3: Transforming Provinces Type B	Kw 1: Agricultural-Based Provinces
Sumatera Utara, Sumatera Barat, Riau, Jambi, Lampung, Kepulauan Bangka Belitung, Kalimantan Barat, Kalimantan Tengah, Sulawesi Utara, Sulawesi Selatan, Sulawesi Barat, dan Maluku Utara.	Aceh, Bengkulu, Nusa Tenggara Barat (NTB), Nusa Tenggara Timur (NTT), Sulawesi Tengah, Sulawesi Tenggara, Gorontalo, dan Maluku.
Kw 4: Urban Provinces	**Kw 2: Transforming Provinces Type A**
Sumatera Selatan, Kepulauan Riau, Jawa Barat, Jawa Tengah, DI Yogyakarta, Banten, Bali, Kalimantan Selatan, Kalimantan Timur, Kalimantan Utara, dan DKI Jakarta.	Jawa Timur, Papua Barat, dan Papua.

Source: BPS (processed)

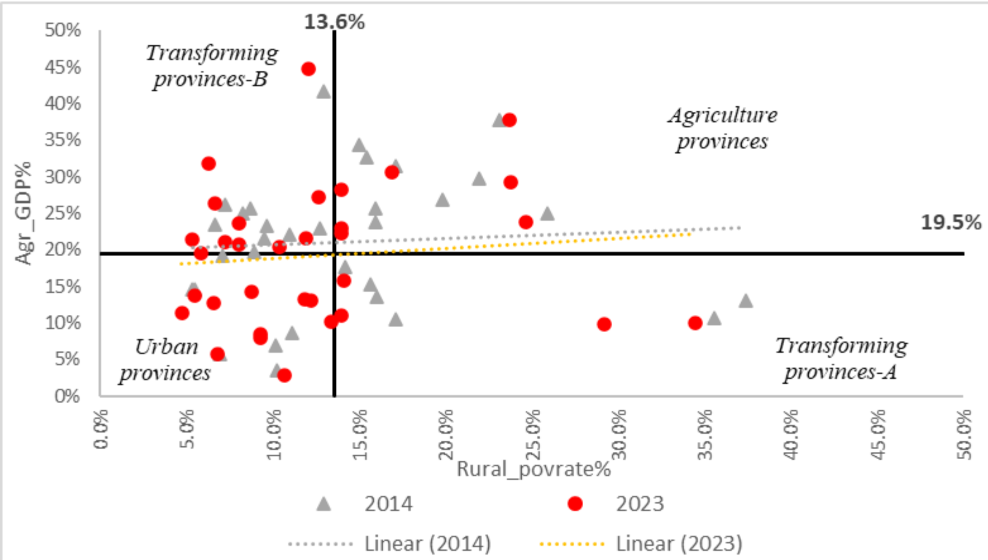

Figure 4: Distribution of Rural Poverty Rates and Proportion of Agricultural Sector in Provinces in Indonesia in 2014 and 2023

Source: BPS (processed)

In the 10-year period (2014-2023), there has been a transformation/change in regional categories in 10 provinces. The transformation trend is moving from the agriculture-based and transforming (A and B) to the urban category. This phenomenon means that there is a tendency for a decrease in the proportion of the agricultural sector in the economy, followed by a decrease in poverty rates in rural areas in each province. In 2023, the average rural poverty rate stood at 13.6%, while the average distribution of the agricultural sector stood at 19.5%. It was recorded that there were three additional provinces in the Urban category and one province in the Transforming-B category in 2023 compared to 2014. Meanwhile, there was a decrease in two provinces in the agriculture-based and the transforming-A categories. The changes in categories in the various provinces are diverse. The Bangka Belitung Islands Province "moved up a class" from the Agriculture-Based into the Transforming-B category. The provinces of South Sumatra, Central Java, and DI Yogyakarta rose from the Transforming-B category to the Urban category. Meanwhile, the Bangka Belitung Islands experienced a "downgrade" from the Urban to the Transforming-B category.

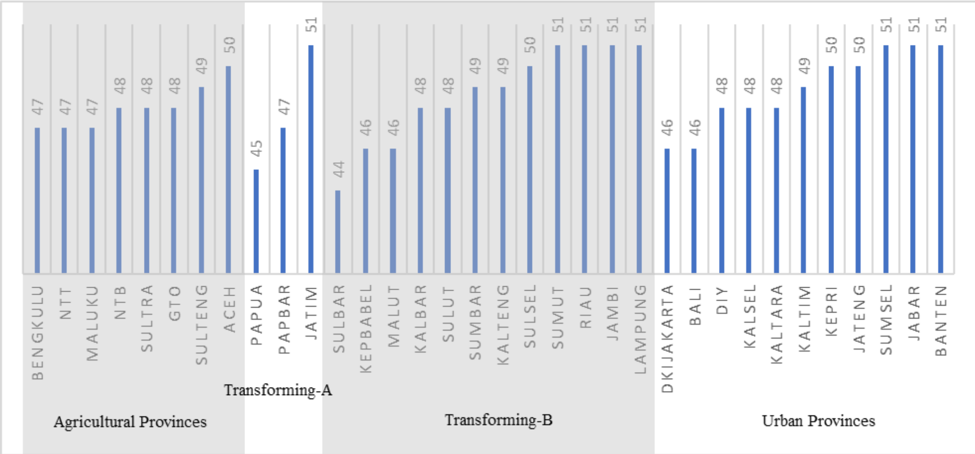

Figure 5: Number of Sub-Sectors Analyzed in the IRIO Matrix by Province

Source: BPS (processed)

The IRIO matrix analyzed in this paper has dimensions of [1649 x 1649], which is reduced from its original dimensions of [1768 x 1768]. This reduction was carried out because there was no input in several subsectors in some provinces. The matrix elements also underwent a 13% decrease, going from 3,125,824 elements to 2,719,201 elements. Certain provinces and sectors have 119 types of input-output matrices that are not included in the analysis due to inactivity. The railway transportation subsector is the type of input that is least often owned by various provinces to produce output. Of the 34 provinces, only 10 in Java and Sumatra have input from this subsector. Meanwhile, other subsectors that are not available in various provinces are generally mining and manufacturing sectors, including the Coal and Lignite Mining subsector (only in 13 provinces); Coal and Oil and Gas Refining Industry (16 provinces); Tobacco Processing Industry (19 provinces); Oil, Gas, and Geothermal Mining (23 provinces); and Basic Metal Industry (24 provinces).

There are no provinces that could provide complete input (52 subsectors) in producing all types of output. In general, provinces in the Eastern Indonesia Region have the fewest types of input provisions. The provinces with the fewest types of input are West Sulawesi (44 subsectors) and Papua (45 subsectors). Meanwhile, the provinces with the most complete input provision per type are North Sumatra, Riau, Jambi, South Sumatra, Lampung, West Java, East Java, and Banten. Each of these provinces could provide input from 51 types of subsectors. DKI Jakarta Province is the only province with types of input from the agricultural sector that do not contribute to output of any type. These inputs include the Seasonal and Perennial Plantation subsectors and the Forestry and Logging subsector. There is no pattern in the provision of types of input by regional category[7]. However,

[7] Agriculture-based Provinces, Type A Transforming Provinces, Type B Transforming Provinces, and Urban Provinces.

agriculture-based provinces generally have the lowest variation in types of input in contributing to output. As many as 6 out of 8 provinces in this category have 4 to 5 types of input subsectors, generally from the mining and manufacturing sectors, which do not contribute anything to output production. In addition, there is not a single input from the rail transportation subsector in the provinces in the agriculture-based region.

Table 3: Types of Input-Output that Do Not Have Transactions Between Sectors and Regions (units)

Regions / Sectors	Agriculture-Based	Transforming-A	Transforming-B	Urban
Agriculture				2
Mining	16	6	15	19
Manufacturers	6	7	11	12
Services	7	3	8	7

Source: BPS (processed)

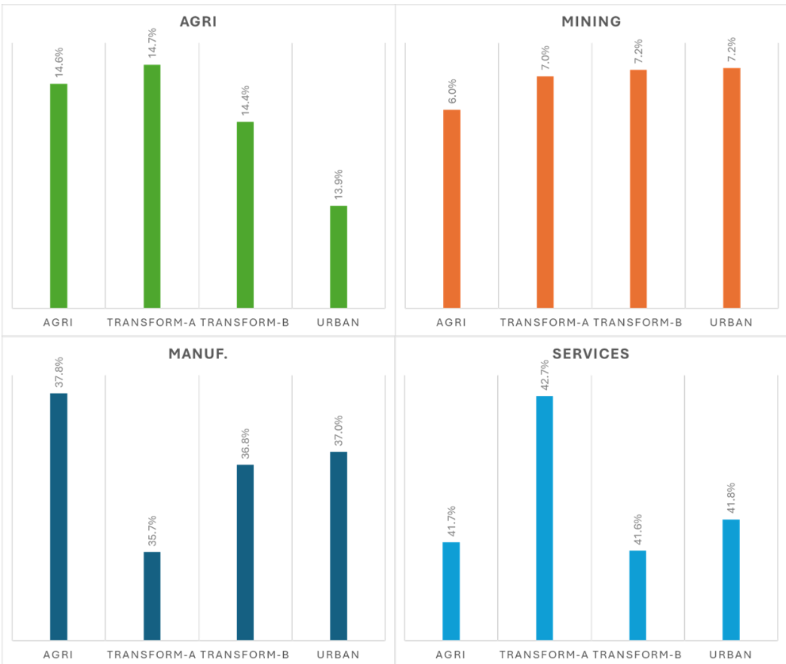

Figure 6: Distribution of Sectoral Input Elements by Regional Category in the Reduced **IRIO Matrix**
Source: BPS (processed)

In the matrix reduction results, we can see a comparison of economic activity between regions based on how the elements of the reduced matrix are spread out (Figure 6). In general, the activities of sectors in the agriculture-based region are relatively not much different from other regions. What stands out is the relatively high manufacturing sector in this region compared to other regional categories, with an average element reaching 37.76% of the total elements in each province. Although not as high as other regions, the portion of the service sector in this agriculture-based region is also quite high (above 40%). Meanwhile, the proportion of the agricultural sector in this region is in second place after the type A Transforming Region (14.6%). The problem is the sectors in this region have the smallest economic added value compared to other regions. Based on its productivity level, the average GDP per capita in this region is at the bottom of Rp 48.32 million. The urban area has the highest per capita GDP at Rp 115.51 million. Meanwhile, the transforming areas of type A and type B have productivity of Rp 82.65 million and Rp 69.68 million per capita, respectively.

4.1 Results of Updating the IRIO Matrix RAS 2016 to 2023

The results of updating the IRIO matrix using the RAS method were successfully carried out after three iteration processes. The RAS matrix in the third iteration was selected after considering the standard error values of the U vector (sum of Z by column) and V (sum of Z by row), which had shown numbers below 0.0005 against the U&V vector of the initial condition (2016). The standard error limit is as suggested in Nazara (2005). The RAS matrix in the third iteration will be used as the intermediate input matrix (Z) in the analysis of this paper. In the second iteration, the standard error number was already below the provision, but for the sake of reducing the estimation error, it was continued to the third stage. Checking this standard error was carried out through simple linear regression on the two variables (Figure 7).

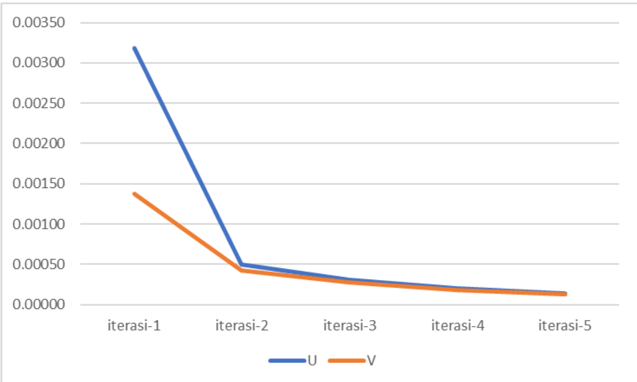

Figure 7: Standard Error Value Between Original Vector U and V in 2016 Against Various Iteration Results in 2023

Source: BPS (processed)

4.2 Technical Coefficient (A)

The technical input coefficient matrix contains 2,719,201 elements, which is the same number of elements found in the reduced IRIO matrix, encompassing various types of inputs and outputs. This coefficient explains the magnitude of the input's contribution to producing output. A high coefficient value indicates the specialty of the input, while a low coefficient value indicates the role of the input as a supporter in the production system.

Among the input coefficient matrix elements, there are 940,562 elements (34.59% of the total matrix elements) with a technical input coefficient value of zero. This means that the type of input from the element does not contribute to producing the related output[8]. These elements can also be classified based on their interprovincial and intraprovincial relationships[9]. The average number of zero-value elements in each province is 27,196. The province with the most zero elements is in North Kalimantan with 43,699 elements (4.65%), and the fewest are in Central Java with 12,991 elements (1.38%). Meanwhile, on the output side, the province with the most elements is Papua with 31,979 (3.4%), and the fewest are in Southeast Sulawesi with 22,050 elements (2.34%). The intra-provincial production process has a total of 15,889 technical input coefficient elements with zero values (1.69%), averaging 467 elements per province. The distribution is the same in terms of input and output, where the largest province is Banten with 876 elements (0.09%) and the least is Southeast Sulawesi province with 231 (0.02%). The input side has the highest inequality of elements between provinces, and the output side has the lowest. There is no specific pattern regarding the distribution of these elements based on regional categories.

Table 4: Number of Intermediate Input Coefficient Elements in the IRIO Matrix that are Zero Valued by Province[10]

Satistics	Inter		intra
	Ai	Aj	Aij
max	43699	31979	876
	4.65%	3.40%	0.09%
	KALTARA	PAPUA	BANTEN
min	12991	22050	231
	1.38%	2.34%	0.02%
	JATENG	DKI JAKARTA	SULTRA
avg	27196	27196	467
	2.89%	2.89%	0.05%
Std.Dev	0.94%	0.23%	0.01%

Source: BPS (processed)

[8] The value of zero on an element is different from the absence of a particular input usage. When there is no input usage, then automatically all elements along the input row, as well as similar output columns, will be zero.
[9] We use inputs from one province to produce output in another province.
[10] Ai is inter-provincial from the input side, Aj is inter-provincial from the output side, and Aij is intra-provincial. The value of Aij on the input side is the same as on the output side.

Meanwhile, according to its sectoral distribution, the agricultural sector has the most technical input coefficient elements with zero values, while the service sector has the least. When viewed from the inter-sectoral input side, the number of elements with the most zero values is in the Agricultural and Hunting Services sub-sector with 54,151 elements (5.76%), while the least number is in the Rail Transportation sub-sector with 40 elements (0.00%). On the output side, the distribution of zero-value elements tends to be uniform. The most are in the Gas Procurement and Ice Production sub-sector with 22,614 elements (2.40%), while the least number is in the Rail Transportation sub-sector with 5,751 elements (0.61%). Intra-sectorally, the input and output elements are the same in number and type. The elements with the most zero values are in the Agricultural and Hunting Services sub-sector with 1,156 elements (0.12%), while the least are in the River, Lake, and Crossing Transportation sub-sector with only 2 elements.

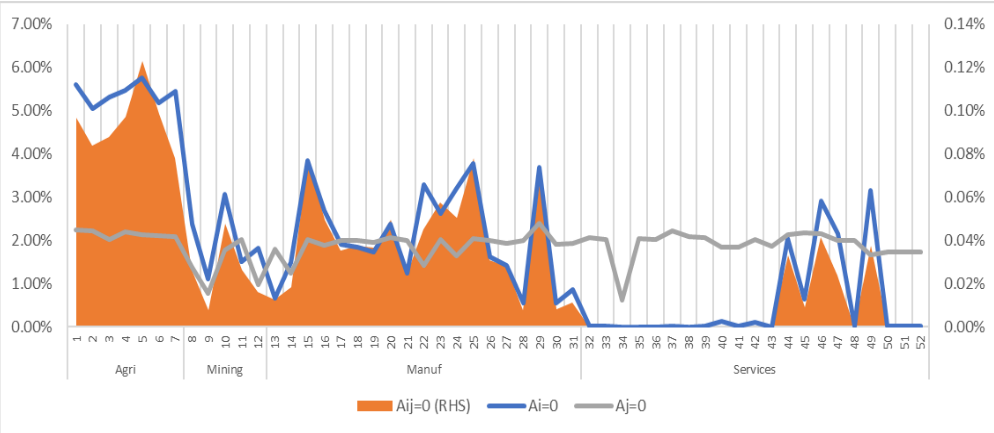

Figure 8: Distribution of Intermediate Input Coefficients in the IRIO Matrix with Zero Values by Sector

Source: BPS (processed)

The technical input coefficients in the matrix that are not zero are 1,778,639 elements, or 65.4% of the total elements in the matrix. The results of calculating the technical input coefficient values across provinces and sectors show varying numbers with very high inequality. We can see this difference and distribution by examining the region, sector, and the way these inputs are used by looking at the statistical data and inequality index of the input coefficients for various types of output. The method used to calculate the inequality index between coefficients here is the Gini ratio method.

Table 5: Distribution of Intermediate Input Coefficients in the IRIO Matrix with Zero Values by Sector[11]

Satistics	Inter		intra
	Ai	Aj	Aij
max	54151	22614	1156
	5.76%	2.40%	0.12%
	Agricultural Services and Hunting	Gas Supply and Ice Production	Agricultural Services and Hunting
min	40	5751	2
	0.00%	0.61%	0.00%
	Railways Transportation	Railways Transportation	River, Lake and Ferry Transportation
avg	17787	17787	422
	1.89%	1.89%	0.03%
Std. Dev	1.84%	0.35%	0.03%

Source: BPS (processed)

On the input side, the Gini index value for all elements shows a nearly perfect inequality condition (gini_Ai_total) (0.980). According to the province, the highest inequality between elements is in West Sulawesi (0.994), and the lowest is in DKI Jakarta (0.909). The main contributor to inequality comes from the interprovince (gini_Ai) at 0.974, although the inequality of intraprovincial elements (gini_Aij) is also relatively high (0.854). Inequality on the output side (gini_Aj_total) also shows a nearly perfect value (0.980), where the inequality of intra-provincial elements (gini_Aj) displays a figure of 0.974[12]. The highest inequality is in the province of NTB (0.983), and the lowest is in the province of North Sumatra (0.957). What distinguishes the two is that the value of the input-side inequality index is more varied, while on the output side it is slightly more uniform. The high disparity in the indices on the input side shows a pattern of input absorption that varies in each province, while on the output side it shows the production capacity of various outputs whose scale is relatively limited and similar in each province.

[11] Ai is inter-subsector from the input side, Aj is inter-subsector from the output side, and Aij is intra-subsector. The value of Aij on the input side is the same as on the output side.

[12]The average intra-provincial inequality value (gini_Aij) has the same value between the input and output sides.

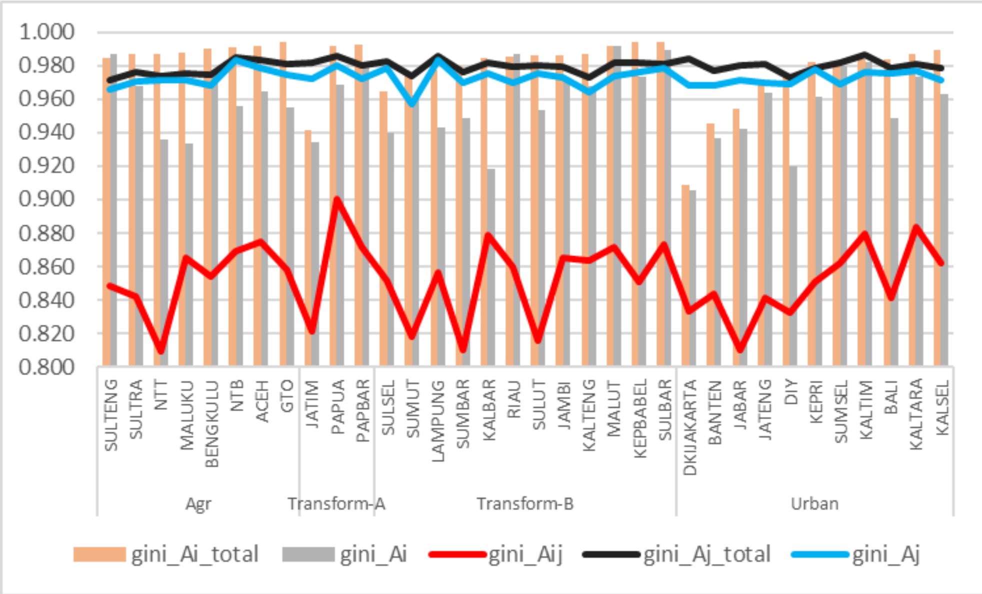

Figure 9: Inequality Index of Input Coefficient Elements Between in IRIO Matrix by Province

Source: BPS (processed)

The level of inequality and diversity of technical coefficient data occurs even at the decile level (Table 6). Inequality is seen from the increase in the average value between deciles, which reaches 200% to 1000%. Even between the first and last deciles[13], the increase reaches 45 and 86 times, respectively. The level of diversity within the decile is also very high. The highest diversity is in the first and last deciles, while the lowest occurs in the middle deciles, especially between the 6th and 8th deciles. This distinction can be seen from the ratio of the average value of each decile to its standard deviation value[14]. A high ratio value (low diversity) indicates a high density (concentration) of elements that occupy space in each class, while also representing high input and output activity there. While a low ratio value (high diversity) indicates a low density of elements, there are only inputs and outputs that interact specifically in that class. Low input contribution in the first class indicates the status of each class' input as a complementary material, while high contribution in the last class indicates the status as a main material. Both can play equally significant roles in their respective production chains. This indicates that the inequality occurs due to differences in input usage patterns in production activities in each province. This observation is reinforced by the ratio (average value of decile to standard deviation), which is almost similar in each regional category.

[13] An increase from the first decile to the second decile, and an increase from the ninth decile to the last decile.

[14] The ratio between the standard deviation value and the mean value is not used here, so that the resulting value scale is easier to interpret.

Table 6: Summary of Technical Input Coefficient Values Based on Decile Class

Decile	Obs	Mean	Std. Dev.	Min	Max	mean/stdev				
						All	Agri	Trans-A	Trans-B	Urban
decile-1	177,864	2.44E-11	3.31E-11	-4.23E-17	1.27E-10	0.737	0.725	0.654	0.722	0.798
decile-2	177,864	1.11E-09	8.83E-10	1.27E-10	3.27E-09	1.257	1.233	1.267	1.244	1.277
decile-3	177,864	1.14E-08	6.36E-09	3.27E-09	2.57E-08	1.792	1.782	1.844	1.792	1.808
decile-4	177,864	6.43E-08	2.82E-08	2.57E-08	1.24E-07	2.280	2.287	2.291	2.265	2.288
decile-5	177,864	2.63E-07	9.81E-08	1.24E-07	4.67E-07	2.681	2.676	2.675	2.684	2.688
decile-6	177,864	9.04E-07	3.06E-07	4.67E-07	1.54E-06	2.954	2.948	2.945	2.948	2.967
decile-7	177,864	2.90E-06	9.60E-07	1.54E-06	4.91E-06	3.021	3.008	3.028	3.010	3.025
decile-8	177,864	9.62E-06	3.46E-06	4.91E-06	1.72E-05	2.780	2.756	2.794	2.786	2.795
decile-9	177,864	4.18E-05	2.05E-05	1.72E-05	9.24E-05	2.039	2.010	2.052	2.044	2.063
decile-10	177,863	3.63E-03	1.64E-02	9.24E-05	7.14E-01	0.222	0.253	0.220	0.216	0.224

Source: BPS (processed)

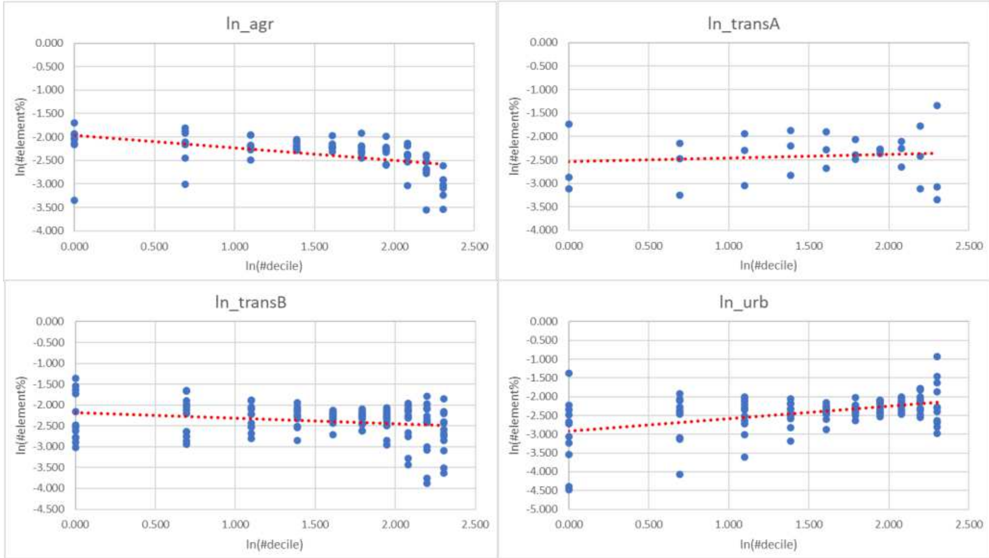

Figure 10: Correlation of Technical Input Coefficient Decile and Number of Elements Within by Regional Category

Source: BPS (processed)

Urban and Transforming-A areas have a correlation between the decile class level and the number of elements that tends to be positive, while Agricultural-Based and Transforming-B areas are negatively correlated (figure 10). A positive correlation means that in these areas, production activities focus on using many resources to create outputs; on the other hand, a negative correlation shows that production activities in these areas use fewer, less valuable resources. We need to evaluate inefficient production practices in these negatively correlated areas to prepare for economic development in each region. Policies that are oriented towards efficient use of inputs can be taken either by encouraging the use of efficient technology, increasing workforce capacity, or improving institutions related to the value chain system there.

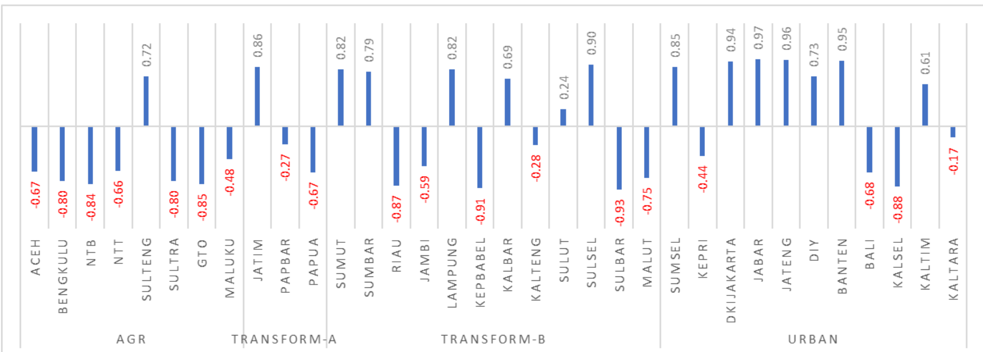

Figure 11: Correlation Coefficient of Decile Class of Technical Input Coefficient and Number of Elements in It by Province

Source: BPS (processed)

Meanwhile, in the sectoral dimension, the Gini index value for each sector, considering both input and output sides, is nearly equal to one, indicating that the inequality is almost perfect (Table 7). The Gini index for each sector shows the difference in the amount of input in a sector used to produce various types of output, or vice versa, as the difference in sector output produced using various types of input. On average, the lowest level of inequality on the sectoral side occurs in sectors that have similar inputs and outputs. The forestry and logging subsector has the lowest intra-sector inequality coefficient. While overall, the lowest average inequality on the input side occurs in the agricultural sector, the subsector with the lowest inequality is the agricultural and hunting services. This happens because the production activities mainly rely on basic materials and simple work methods, which results in very little economic value despite being done on a large scale. Meanwhile, when viewed from the output side, the tendency for low coefficient inequality occurs in various service sector outputs. The subsector with the lowest inequality between provinces is the education service. The relatively uniform output of the service sector, in terms of output, is due to the comparatively more uniform products produced in this sector. In the case of educational services, for example, the products tend to have the same quality throughout Indonesia because this category is mostly included in basic services managed by the government with standardized quality.

Table 7: Inequality Index of Technical Input Coefficient Elements in the IRIO Matrix by Sub-Sector[15]

Stat.	gini_Ai_total	gini_Ai	gini_Aij	gini_Aj_total	gini_Aj
max	0.998	0.998	0.987	0.993	0.992
	Tobacco Processing Industry	Metal Ore Mining	Gas Procurement and Ice Production	Electricity	Basic Metal Industry
min	0.866	0.866	0.820	0.962	0.962
	Agricultural and Hunting Services	Agricultural and Hunting Services	Forestry and Logging	Educational Services	Other Services
Total	0.980	0.979	0.968	0.980	0.979
Agriculture	0.943	0.947	0.871	0.982	0.981
Mining	0.982	0.983	0.940	0.982	0.979
Manufacturing	0.983	0.978	0.950	0.982	0.981
Services	0.961	0.959	0.944	0.973	0.973

Source: BPS (processed)

[15] ***gini_Ai_total*** is the total inequality index between elements of the input side, ***gini_Ai*** is the inter-subsector input side inequality index, and ***gini_Aij*** is the intra-subsector inequality index. ***gini_Aj_total*** is the total inequality index between elements of the output side, and ***gini_Aj*** is the inter-subsector output side inequality index.

4.3 Leontief Multiplier Coefficient $(I-A)^{-1}$ and Output Multiplication Impact (ΔX)

The average overall impact (L) of multiplying total output on various types of inputs is 1.679766. This means that if there is a stimulus in the form of final demand of Rp 1 trillion in a sector, then the additional output that will be formed on it is Rp 1.679766 trillion. The composition of the additional output formed consists of the direct impact on the relevant input (direct) of Rp 1.04816 trillion16, while the indirect impact is Rp 0.63161 trillion, which arises from the use of inputs apart from the main input. The summary of the impact of doubling the total output can be further classified according to the location of the province where an input is located (intra-province) or from other provinces affected by the demand for the input (inter-province), as summarized in table 8. Further investigation found that the highest overall impact was in Bali province for the electricity subsector input worth IDR 4,186,459 trillion (including stimulus/outlay of IDR 1 trillion) and the lowest in Riau province for the forestry and logging subsector worth IDR 1,05091 trillion. The highest direct overall impact was in North Maluku province for the electricity subsector, worth IDR 2,018,319 (after deducting outlay), and the lowest was in Gorontalo province from the tobacco processing industry subsector, worth 1.15x10-14. Meanwhile, the highest overall indirect impact is in DI Yogyakarta for the electricity sector, with a total multiplication of IDR 2,561,176 trillion, and the lowest impact is in Riau province for the forestry and logging subsector, worth IDR 0.0445,916 trillion.

Table 8: Simulation Statistics of Distribution of Average Aggregate Impact of Doubling Output for Every Additional IDR 1 trillion of Final Demand for Various Inputs in Total, Intra, and Inter Province

Statistics	Overall			Intra			Inter		
	Total	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect
Obs	1649	1649	1649	1649	1649	1649	1649	1649	1649
Mean	1.679766	1.04816	0.63161	1.36482	1.048121	0.3166997	0.3149453	3.57E-05	0.31491
Std.Dev.	0.3576556	0.13831	0.29827	0.2280696	0.1382844	0.1775565	0.2125616	0.000167	0.21255
Min	1.05091	1	0.04459	1.00201	1	0.0020098	0.0118213	0	0.011816
Max	4.186459	3.01832	2.56118	3.318552	3.018318	1.160401	2.458446	0.002935	2.45814

Source: BPS (processed)

16 In this direct impact, the impact value of IDR 1,04816 is split into a spending amount (the final demand stimulus itself) of IDR 1 trillion and the leftover impact of IDR 0.04816 trillion, which represents the added value from the related input demand.

The largest impact of input multiplication intra-provincially in North Maluku is in the electricity sector, with a total output multiplication reaching Rp 2,018,318. Bangka Belitung Islands province has the least impact on the oil, gas, and geothermal mining subsector, with a multiplication value of Rp 1.00201 trillion. Intra-provincially, it is also known that the largest direct multiplication impact is in North Maluku province for the electricity sub-sector with a value of Rp 2,018,318 trillion (without outlay), and the smallest is in Maluku province for the rubber, rubber goods, and plastic industry sub-sector with a multiplication value of Rp 2.89x10-11 trillion. West Nusa Tenggara province has the largest indirect multiplication in the gas procurement and ice production subsector, with a value of Rp 1,160,401 trillion. Meanwhile, the smallest is in the Bangka Belitung Islands province for the oil, gas, and geothermal mining sub-sector, with a value of IDR 0.0020098 trillion.

Finally, for the total impact of inter-provincial multiplication (outside the province concerned), the highest is in the DI Yogyakarta province in the electricity sub-sector, worth IDR 2,458,446 trillion. The Riau province has the lowest impact in the forestry and logging sub-sector, valued at IDR 0.0118213 trillion. The highest direct impact is in the South Sumatra province for the oil, gas, and geothermal mining sub-sector, worth IDR 0.0029347 trillion (without outlay), while the lowest is in the Central Sulawesi province for the tobacco processing industry sub-sector, worth IDR -1.46x10-11. The negative value here indicates a backwash that occurs outside the input. Meanwhile, the largest indirect inter-provincial impact occurred due to demand in the electricity sub-sector in the DI Yogyakarta province of IDR 2.45814 trillion, and the lowest was in Riau province for the forestry and logging sub-sector of IDR 0.0118162 trillion.

Meanwhile, because the final demand simulation is carried out according to each type/component of input, the aggregate value of the direct impact is the same, both in the overall output multiplier coefficient element (L), intra-province (L_inti), and inter-province (L_inter). Meanwhile, the distribution of the largest indirect output impact elements according to the total Leontief coefficient (L) is in the Electricity sub-sector of the West Nusa Tenggara province, which comes from the stimulus demand for input in the Gas Procurement and Ice Production sub-sector from West Nusa Tenggara of IDR 0.999 trillion for each additional final demand of IDR 1 trillion. Meanwhile, the lowest output impact is in the Forestry and Logging sub-sector in the Riau Islands province, with input coming from the Metal Ore Mining sub-sector of the Riau Islands province of IDR -1.76x10-28 trillion. Furthermore, in the interprovincial Leontief coefficient type (L_inter), it is known that the largest direct output element distribution impact is IDR 0.999 trillion in the Electricity subsector in West Nusa Tenggara province with input from the Gas Procurement and Ice Production subsector in West Nusa Tenggara province. Meanwhile, the lowest impact of IDR -4.27x10-17 trillion is in the Non-Metallic Mining Industry subsector in Central Sulawesi province, which comes from input from the Construction subsector in Central Sulawesi province. Finally, in the intraprovincial Leontief coefficient type (L_intra), the biggest direct output impact is IDR 0.751 trillion in the Coal and Lignite Mining subsector in South Sumatra Province, which comes from the Electricity subsector in the Bangka Belitung Islands province. Meanwhile, the smallest impact is IDR -3.36x10-31 trillion in the Forestry and Logging subsector of Kep. Riau, which gets input from the Basic Metal Industry subsector of South Sumatra province. Meanwhile, the lowest is IDR -3.36x10-31 trillion in the Forestry and Logging subsector of Kep. Riau with input from the Basic Metal Industry subsector of South Sumatra province.

Table 9: Statistics of Distribution of Leontief Multiplier Coefficient Matrix Elements Total, Intra, and Inter Province According to Decile

Statistics		Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10
Obs	L	271,921	271,920	271,920	271,920	271,920	271,920	271,920	271,920	271,920	271,920
	L_inti	7,935	7,934	7,934	7,934	7,934	7,934	7,934	7,934	7,934	7,934
	L_inter	271,903	271,903	271,903	271,903	271,903	271,903	271,903	271,903	271,903	271,902
Mean	L	1.90E-08	1.65E-07	5.90E-07	1.55E-06	3.52E-06	7.61E-06	1.67E-05	3.94E-05	1.21E-04	1.00E-02
	L_inti	3.12E-06	3.50E-05	1.20E-04	2.86E-04	5.92E-04	1.19E-03	2.39E-03	5.04E-03	1.20E-02	2.62E-01
	L_inter	1.90E-08	1.65E-07	5.89E-07	1.54E-06	3.50E-06	7.56E-06	1.65E-05	3.87E-05	1.15E-04	1.73E-03
Std. Dev.	L	1.80E-08	7.34E-08	1.83E-07	3.89E-07	7.96E-07	1.68E-06	3.86E-06	1.05E-05	4.65E-05	8.32E-02
	L_inti	3.73E-06	1.72E-05	3.89E-05	6.72E-05	1.26E-04	2.39E-04	4.99E-04	1.15E-03	3.40E-03	4.11E-01
	L_inter	1.80E-08	7.35E-08	1.84E-07	3.96E-07	8.24E-07	1.77E-06	4.17E-06	1.15E-05	5.06E-05	8.39E-03
Min	L	-1.76E-28	6.06E-08	3.15E-07	9.51E-07	2.30E-06	5.07E-06	1.09E-05	2.44E-05	6.13E-05	2.30E-04
	L_inti	-6.44E-18	-4.98E-18	-3.01E-17	-4.27E-17	-4.08E-17	-1.57E-19	1.95E-04	1.36E-03	2.08E-03	1.22E-02
	L_inter	-3.36E-31	5.19E-13	9.55E-12	1.71E-11	2.02E-11	7.73E-12	2.18E-11	1.60E-10	5.24E-10	4.66E-10
Max	L	6.06E-08	3.15E-07	9.51E-07	2.30E-06	5.07E-06	1.09E-05	2.44E-05	6.13E-05	2.30E-04	3.02E+00
	L_inti	1.26E-05	7.02E-05	1.92E-04	4.14E-04	8.36E-04	1.65E-03	3.37E-03	7.40E-03	1.96E-02	3.02E+00
	L_inter	6.06E-08	3.15E-07	9.50E-07	2.30E-06	5.06E-06	1.09E-05	2.44E-05	6.13E-05	2.30E-04	7.51E-01

Source: BPS (processed)

The distribution pattern of the Leontief coefficient, elementally, has high inequality and dispersion (table 9). The distribution pattern of the deciles is almost the same as the distribution of the technical input coefficient (A), especially when viewed from the curve of the ratio of the average value (mean) to the standard deviation value (figure 12). Each decile essentially creates a downward-opening parabolic pattern. The peak of the curve represents the center of the values of the coefficients. The values are also almost the same between L, L_inti, and L_inter. The data pattern of these elements varies the most in the first and last classes,le it is the most uniform (especially) in deciles 5, 6, and 7. Referring to table 10, it is known that in deciles 5-7 the input elements in the agriculture-based, transforming type A, and type B regions mostly come from the service sector. While in the urban area, it actually comes from the agriculture sector.

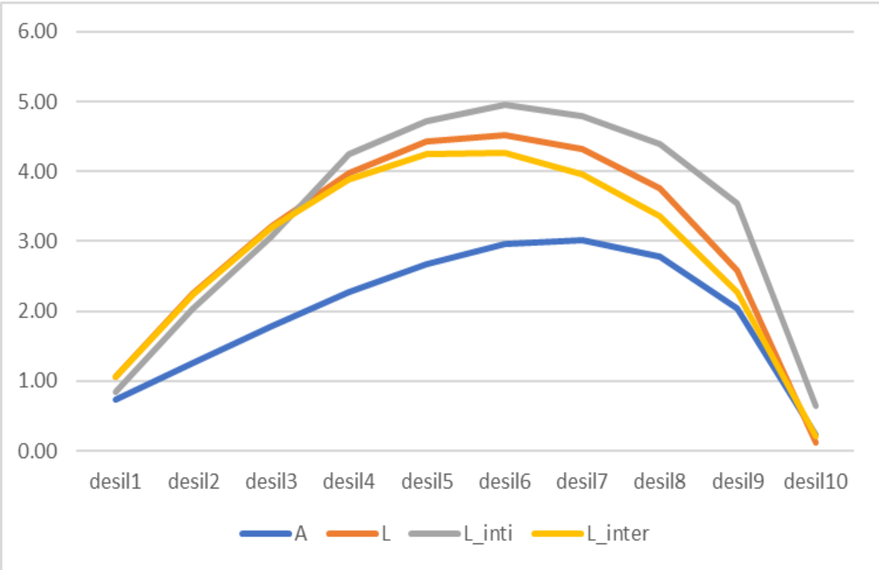

Figure 12: Ratio of Mean Value to Standard Deviation of Each Decile on Technical Input Coefficient (A) and Total, Intra, and Inter Province Leontief Coefficients

Source: BPS (processed)

Inputs in agricultural-based areas tend to have low (agriculture, mining, and manufacturing) to moderate (services sector) output multiplication rates, while other areas have varying output multiplication characteristics. In the Transforming A area, agricultural and manufacturing sector inputs generally have low output multiplication rates, while the mining and services sectors tend to have high impacts. Inputs from the agricultural and manufacturing sectors in the Transforming B area generally have low output multiplication rates, while the mining and services sectors tend to be spread across levels. In urban areas, relatively high output multiplication rates come from the mining and services sectors. Meanwhile, agricultural input multiplication rates are generally low, and the manufacturing sector tends to be evenly spread.

Table 10: Percentage of Total Input Elements by Decile Overall Impact (L) of Output Multiplication[17]

deciles	Agriculture Base			
	Agri	Mining	Manuf.	Services
<d4	54.3%	48.0%	75.0%	35.6%
d5-7	32.9%	29.6%	16.5%	43.5%
>d8	12.8%	22.4%	8.5%	20.9%

deciles	Transform-B			
	Agri	Mining	Manuf.	Services
<d4	40.3%	39.7%	59.6%	27.0%
d5-7	35.3%	33.9%	23.3%	37.7%
>d8	24.4%	26.4%	17.1%	35.3%

deciles	Transform-A			
	Agri	Mining	Manuf.	Services
<d4	53.7%	33.9%	54.6%	27.7%
d5-7	19.3%	17.2%	16.5%	31.0%
>d8	27.0%	48.9%	28.9%	41.3%

deciles	Urban			
	Agri	Mining	Manuf.	Services
<d4	43.8%	28.1%	37.4%	13.5%
d5-7	37.0%	22.4%	25.6%	31.0%
>d8	19.2%	49.5%	37.0%	55.5%

Source: BPS (processed)

4.4 Forward Linkage Index (IKD), Backward Linkage Index (IKB), and Leading Sectors

The results of the classification of inputs based on IKD and IKB values found that there were 167 types, or 10.1% of the total inputs with leading status[18]. Inputs that only had forward advantages were 231 types (14.0%), and those that only had backward advantages were 614 types (37.2%). The remaining 637 types, accounting for 38.6%, lacked any advantages. Table 11 displays the index distribution for each of these leading statuses. Among the 167 inputs with leading status, none came from the agricultural sector. It is in contrast to the conditions of the existence of activities in this sector in all provinces (except DKI Jakarta). It is the impact of subsistence farming practices carried out in various places, in addition to the inefficient trade chain factor.

Meanwhile, the leading inputs from the mining, manufacturing, and services sectors are 5, 119, and 43 units, respectively. Table 12 summarizes the types of subsectors within each sector. In addition to the agricultural sector, there are subsectors within these sectors that do not have leading status. No province has leadingity in the Mining and Other Excavation subsector. Meanwhile, in the manufacturing sector, subsectors that are not leading in any province include the tobacco processing industry and water supply, waste management, waste, and recycling. Meanwhile, the service sector that does not have leadingity in various provinces includes the car, motorcycle, and repair trade subsector; wholesale and retail trade (not cars and motorcycles); rail transportation; river, lake, and ferry transportation; provision of accommodation; financial intermediary services other than central banks; insurance and pension funds; other financial services; financial support services; real estate; government administration, defense, and compulsory social security; education; health and social activities; and other services.

[17] Total sectors in each region = 100.

[18] The Backward Linkage Index (IKB) and Forward Linkage Index (IKD) have values above one.

Table 11: Distribution of IKB and IKD Values According to Input Leading Status

Variable	Obs	Mean	Std.Dev.	Min	Max
Leading					
IKB	167	1.287	0.338	1.001	2.492
IKD		1.868	1.006	1.002	6.752
Forward Leading					
IKB	231	0.863	0.087	0.626	0.999
IKD		1.942	1.761	1.001	17.241
Backward Leading					
IKB	614	1.131	0.093	1.001	1.587
IKD		0.702	0.109	0.595	0.999
Non-Leading					
IKB	637	0.848	0.093	0.626	1.000
IKD		0.718	0.110	0.595	0.998

Source: BPS (processed)

Table 12: Types of Subsectors with Leading Status in Various Provinces

Agriculture:	**Mining:** Oil, Gas and Geothermal Mining; Coal and Lignite Mining; Metal Ore Mining.
Manufacturing: Coal Industry and Oil and Gas Refinery; Food and Beverage; Textile and Ready-made Apparel; Leather, Leather Goods, and Footwear; Wood, Wood and Cork Goods, and Woven Goods from Bamboo, Rattan, and the Like; Paper and Paper Goods, Printing and Reproduction of Recorded Media; Chemicals, Pharmaceuticals, and Traditional Medicines; Rubber and Plastic Goods; Non-Metallic Minerals; Base Metals; Metal Goods; Computers, Electronic Goods, Optical and Electrical Equipment; Machinery and Equipment YTDL; Transportation Equipment; Furniture; Other Processing, Repair, and Installation Services of Machinery and Equipment; Electricity; Gas Supply and Ice Production; Construction.	**Services:** Land Transportation; Sea Transportation; Air Transportation; Warehousing and Transportation Support Services, Post and Courier; Food and Beverage Provision; Information and Communication Services; Company Services.

Source: BPS (processed)

We can also view the analysis of leading sectors from a regional perspective. As explained previously, of the 52 sub-sector units, not all of them have activities in each province. So by referring to Figure 6, the average number of sub-sectors operating in agricultural-based provinces is 48.0 units; provinces undergoing transformation-A are 47.7 units; regions undergoing transformation-B are 48.7 units; and urban provinces are 48.9 units. From this classification, the average number of leading sectors is the largest in the urban area, as much as 11.6%, followed by the medium transforming-A area, as much as 11.3%; the medium transforming-B area, as much as 9.7%; and the agriculture-based area, which is only 7.8% of the total sub-sector units in each province.

Based on the number of leading input subsectors in forward linkage, the average comparison in each province is the most in the urban area at 18.3%, the region undergoing transformation-A at 15.2%, the region undergoing transformation-B at 12.0%, and the agricultural-based area at 10.4% of the total subsector units in each province. The opposite picture is seen based on the backward linkage advantage, where the average is highest in the agricultural-based area at 43.2%, the region undergoing transformation-B at 41.5%, the region undergoing transformation-A at 34.8%, and the smallest in the urban area at 29.3% of the total sub-sector units in each province. Interestingly, the number of sub-sectors that do not have the highest average advantage is in the urban area at 40.8%, followed by the region undergoing transformation-A at 38.7% and the agricultural-based area at 38.6%. Meanwhile, the lowest percentage is found in the transformation area, accounting for 36.8% of the total sub-sector units in each province.

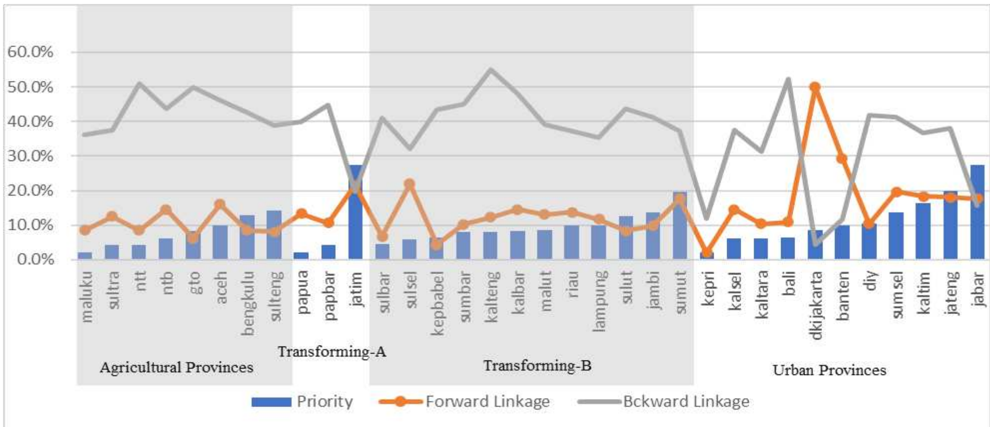

Figure 13: Ratio of the Number of Leading Sub-sectors to the Number of Sub-sectors Having Activities in Each Province

Source: BPS (processed)

The currently low percentage of leading and partially leading sectors (forward/backward linkage) indicates that the sectoral linkages among different industries across various regions remain shallow. Deepening these linkages can actually increase the opportunity for the community to obtain economic benefits from investment in these various sectors.

4.5 Impact of Doubling Gross Domestic Product (GDP)

Linearly, the output multiplication can be used as a reference for estimating the multiplication of other economic indicators. In general, the average simulation of the multiplication of Gross Domestic Product (GDP) indicates that for each unit of demand, such as IDR 1 trillion, the input is approximately IDR 932.4877 billion, which includes around IDR 588.2964 billion in direct impact. While the remaining IDR 344.1913 billion is the indirect impact arising from the multiplication of other sectors in the province concerned, as well as from various sectors from other provinces (see Figure 15). Stimulus with the same level in agricultural-based areas tends to have a higher total multiplication impact than other types of areas. The high marginal output of this area compared to other areas indicates that there are still large investment opportunities in this area.

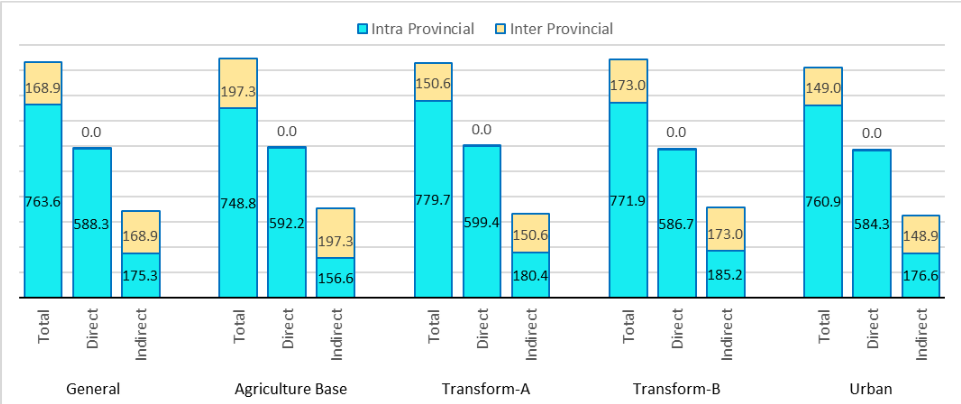

Figure 14: Impact of Simulation of Average GDP Doubling by Regional Category

Source: BPS (processed)

4.6 Impact of Multiplication (Compensation) of Labor

The average overall multiplication of labor compensation caused by each increase in one unit of final demand is Rp360.5 billion (figure 16). Of this multiplication, 65.6% is a direct impact. Or spatially, there are around 83.56% of the multiplications generated in the province where the input is located, while the remaining 16.4% appear in other regions. This multiplication of labor compensation can be capitalized into a form of potential employment opportunities formed in each province. By using the minimum wage value in each province, the average number of jobs that may be formed in the same stimulus as a whole is 128.3 thousand jobs (figure 17). The sector where the input is located generates around 65.4% of the jobs, while other sectors and regions in both the related province and other provinces account for the remaining 34.6%. Approximately 83.3% of the potential jobs are formed in the related province, while the remaining 16.7% are created in provinces outside of that province.

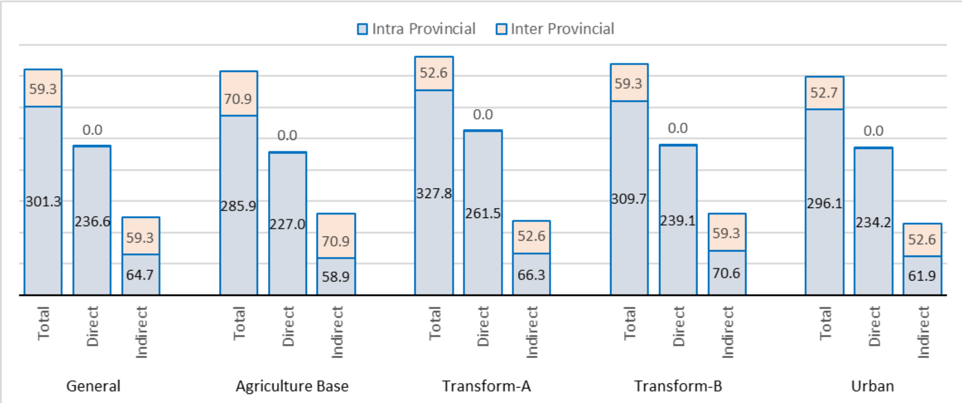

Figure 15: Impact of Simulation of Average Multiplication of Labor Incentives by Regional Category

Source: BPS (processed)

The difference in minimum wage standards in each province results in a difference in the level of multiplication between labor wage incentives and potential employment opportunities created. The highest average labor wage incentives and potential employment opportunities are in the moderately transforming region A, with an amount of Rp380.4 billion and 136.8 thousand jobs, respectively. The disparity between the two regions determines the lowest average wage incentives. The lowest average incentive is in the urban area, with an incentive value of Rp348.8 billion and the potential for employment creation of 126.6 thousand jobs, while according to employment opportunities, the smallest is in the moderately transforming region B, with a total of 123.0 thousand jobs and an average wage value of Rp369.0 billion, or below the level of the moderately transforming region A. Meanwhile, the agricultural sector is in third place in terms of average wage incentives (after the transforming regions A and B), while its potential employment opportunities are in second place with 135.7 thousand jobs.

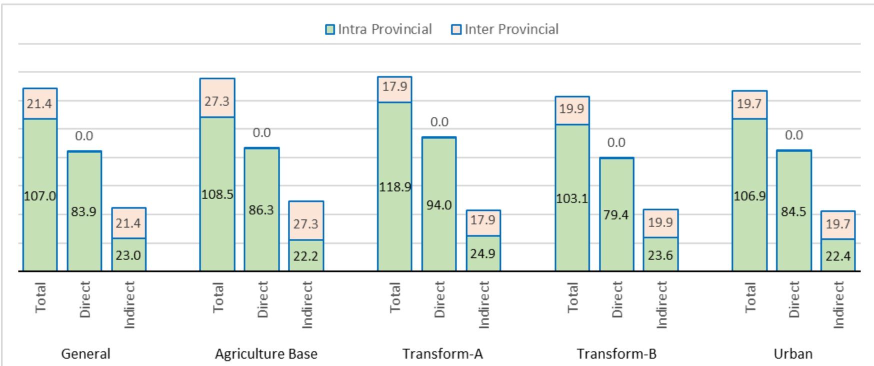

Figure 16: Impact of Simulation of Average Doubling of Workforce by Regional Category

Source: BPS (processed)

4.7 Impact on Foreign Trade (Export and Import)

The average impact of export multiplication that emerged (IDR 137.2 billion) was higher than the impact of increased imports (IDR 67.5 billion) for every IDR 1 trillion of final demand for its inputs. The direct impact on the export side was 59.52%, while the intra-provincial impact (73.38%) was higher than the inter-provincial impact (26.62%). Where on average the largest impact was in the urban area of IDR 186.1 billion, and the lowest impact was in the agricultural-based area of IDR 95.9 billion (figure 18). Meanwhile, 50.59% of the multiplication on the import side came from the direct impact, where the intra-provincial impact (64.46%) was also higher than the inter-provincial impact (35.54%) (figure 19). The highest level of multiplication on imports was in the urban area (IDR 90.2 billion), and the lowest was in the agricultural-based area (IDR 53.9 billion).

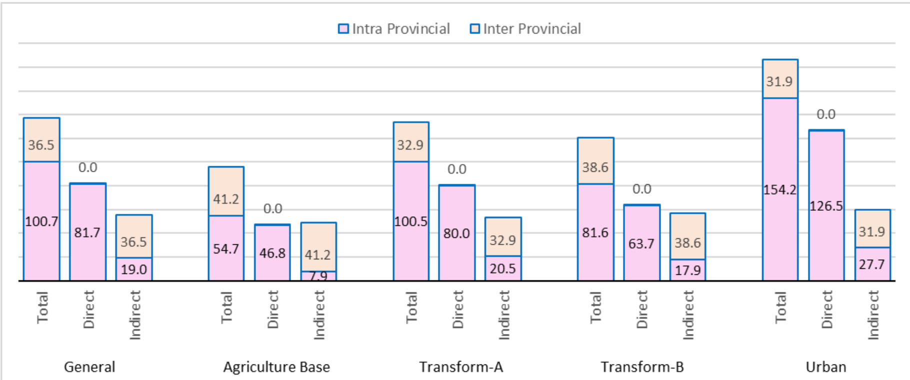

Figure 17: Impact of Simulation of Average Export Multiplication by Regional Category

Source: BPS (processed)

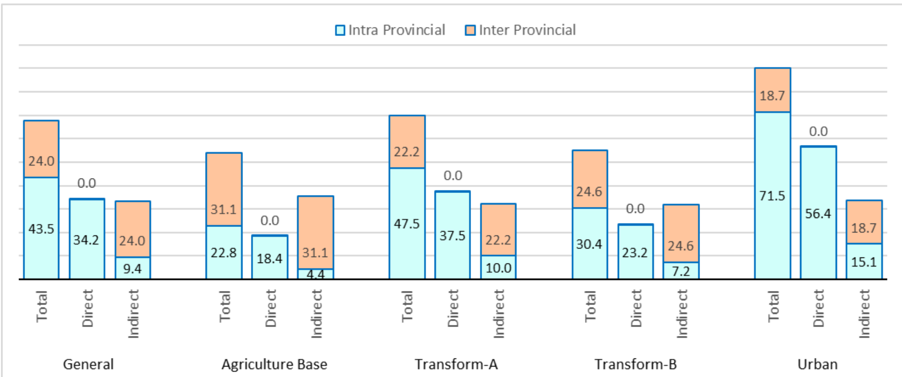

Figure 18: Impact of Simulation of Average Import Multiplication by Regional Category

Source: BPS (processed)

4.8 Impact in Tax/Subsidy

The average tax multiplication (after subtracting subsidies) overall is IDR 25.0 billion per province (figure 20). A direct impact accounts for up to 73.89%, while an intra-provincial impact accounts for around 82.66%. The impact of tax multiplication in the Medium Transforming-B and urban areas is relatively equivalent, with a value of IDR 33.9 billion and IDR 33.3 billion, respectively. This figure is very different from the impact of tax multiplication in the relatively agricultural-based and medium-transforming areas with values of only IDR 5.4 billion and IDR 9.6 billion, respectively. The low impact of this tax multiplication is caused by the less than good output multiplication structure in creating an optimal tax base in each region.

The relatively low output multiplication rate in various sectors of the agriculture-based region (table 10) will ultimately increase the tax burden due to subsidies for those sectors. Meanwhile, the multiplication rate of sectors in the Transforming A region tends to be a dilemma. The character of the mining sector, whose taxes are managed centrally, results in a narrowing of the tax base in this region, even though the majority of activities in this sector have a very high output multiplication rate. Meanwhile, the character of the service sector, which is also predominantly filled with activities with a high output multiplication rate, generally has barriers to entry. Where one of the main obstacles is education. This will certainly burden the distribution of the tax base in this region (especially Papua and West Papua), which generally has chronic problems in terms of fulfilling access to education. Meanwhile, the sectors that are expected to expand the tax base, namely the manufacturing and agricultural sectors, are concentrated on activities with the lowest multiplication scale, which also have the potential to reduce taxes.

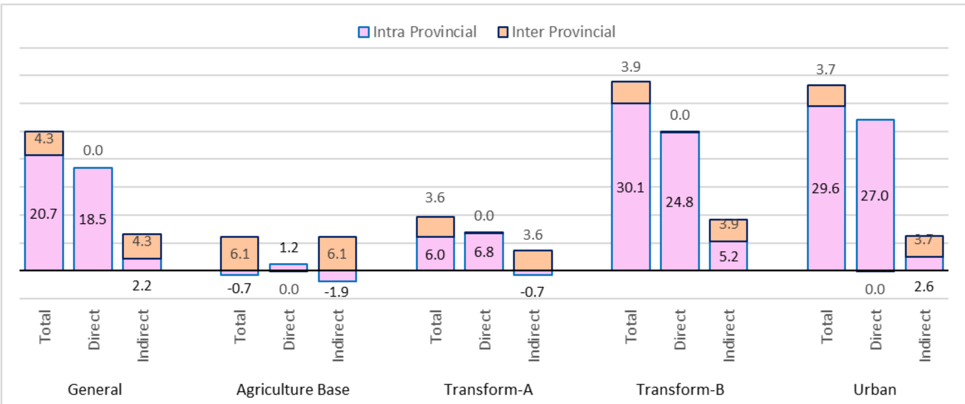

Figure 19: Impact of Simulation of Average Tax/Subsidy Multiplication by Regional Category

Source: BPS (processed)

Referring to the results of the above multiplication findings, a simulation is then carried out in the form of a stimulus simultaneously for all inputs according to their leadingity status. The goal is to determine the potential for multiplication of output, GDP, wage and employment incentives, exports and imports, and net taxes. As mentioned above, in the leading category, there are 167 types of inputs. Each of them is then given a final demand stimulus of IDR 1 trillion simultaneously, so that in total there will be IDR 167 trillion given to this leading category. These leading inputs are spread across the agricultural-based region with as many as 30 types, the medium-transforming-A region with as many as 17 types, the medium-transforming-B region with as many as 57 types, and the urban region with as many as 63 units. The distribution of the potential multiplication is as follows:

Table 13: Simulation of Output Multiplication on Demand of Input Components in Leading Category

Leading	IDR Trilion						Unit
	Output	GDP	Labor Incentive	Export	Import	Taxsubs	Employment
Agriculture	65.78548	27.57767	9.359422	4.775679	2.422326	-2.423	3,504.47366
Transform-A	34.88142	14.97027	5.713938	3.286987	2.029731	-0.177	2,646.05245
Transform-B	125.8636	53.16393	17.45916	10.63461	3.836065	6.702	5,867.50554
Urban	134.6341	56.63323	19.77942	13.40003	6.366766	0.196	8,095.93621

Source: BPS (processed)

In the forward linkages category, stimulus simulations are applied to 231 types of high-quality inputs across 40 types of agriculture areas, 22 types of medium-transforming-A areas, 71 types of medium-transforming-B areas, and 98 types of urban areas. Where the distribution of the potential multiplication is as follows:

Table 14: Simulation of Output Multiplication on Demand of Input Components in Forward Leading Category

Forward Leading	IDR Trilion						Unit
	Output	GDP	Labor Incentive	Export	Import	Taxsubs	Employment
Agriculture	59.06945	38.62362	14.22883	1.377783	1.376385	0.396	5,365.82461
Transform-A	30.7933	21.09764	7.45814	2.18509	0.9023601	0.228	3,019.97946
Transform-B	101.6955	67.91527	25.96392	6.024113	3.084732	0.869	8,725.17876
Urban	143.4335	88.89242	29.60813	12.44993	9.107575	2.545	9,860.05173

Source: BPS (processed)

In the leading backward category (Backward Linkages), the stimulus was applied to 614 different types of inputs across various regions: 166 types in the agricultural-based region, 49 types in the medium transforming-A region, 242 types in the medium transforming-B region, and 157 types in the urban region. Where the distribution of the potential multiplication is as follows:

Table 15: Simulation of Output Multiplication on Demand of Input Components in Backward Leading Category

Backward Leading	IDR Trilion						Unit
	Output	PDB	Labor Incentive	Export	Import	Taxsubs	Employment
Agriculture	314.7906	154.6898	59.85936	21.43175	11.31019	2.534	22,857.85326
Transform-A	91.2688	45.17802	18.17853	8.076374	3.821979	0.162	6,017.45065
Transform-B	461.4589	224.7445	92.09416	42.34142	17.25548	7.061	30,684.42285
Urban	298.6665	143.1318	57.6406	38.36769	13.86816	6.129	21,656.41226

Source: BPS (processed)

In the non-leading category, the final demand stimulus was carried out on 637 inputs spread across the agricultural-based region (as many as 148), the medium-transforming-A region (as many as 55 types), the medium-transforming-B region (as many as 214), and the urban region (as many as 220 types). The distribution of the potential multiplication is as follows:

Table 16: Simulation of Output Multiplication on Demand of Input Components in Non-Leading Category

Non-Leading	IDR Trilion						Unit
	Output	GDP	Labor Incentive	Export	Import	Taxsubs	Employment
Agriculture	211.2703	142.395	53.54518	9.24391	5.605015	1.579	20,396.86392
Transform-A	80.0289	51.7885	23.04006	5.522841	3.211504	1.162	7,882.27795
Transform-B	304.5464	206.0465	79.99629	11.22505	7.953508	5.217	26,544.87977
Urban	311.7468	200.8239	80.61344	35.90618	19.17605	9.039	28,504.36317

Source: BPS (processed)

V. Discussion

The findings above show that the progress of Indonesia's economic transformation is still not optimal at the sub-national level. Provinces in the medium transformation category (transforming A and B) have indeed replaced agriculture-based provinces. The problem is that the level of welfare in these two regions, as measured by GRDP per capita, is below the national average (Rp 80.62 million per capita). This also highlights the inequality that exists between urban and non-urban areas. It is impossible to separate the low income in these areas from the performance of their respective sectors.

The results of the IRIO matrix search show that not all sectors have activities in each province. This conclusion is understandable considering the diversity of natural resources and geographical conditions in Indonesia. In addition, the consumption preferences of the peoples in each region certainly affect the differences in demand and supply for a sector/commodity. The issue at hand pertains to the balanced management of this diversity.

Mitigation efforts need to be made to move various regions with low added value and high poverty rates towards regions with high value and low poverty rates. Previous studies that looked at the same regional categories found that factors like the economy, social progress, and infrastructure help change regions in each province of Indonesia (Abduh, 2023). From a macroeconomic perspective, a strategy of increasing per capita income in the manufacturing and services sectors by one million rupiah can increase the opportunity for a province to transform into an urban area by 10.2% and 35.4%, respectively. A one percent increase in export and import activity (from GRDP) in each province can also increase the opportunity for such transformation by 13.4% and 23.6%, respectively. Meanwhile, efforts to control consumption and production prices in each region play a role in maintaining a transformation climate by an average of 5.5%.

Of course, efforts to increase the added value of each sector (manufacturing and services) are carried out by paying attention to the efficiency aspect in the production process. In Abduh's (2023) study, it was shown that a one percent increase in ICOR would increase the chances of each province being trapped in the agricultural-based and transforming regions by 2% and 0.5%, respectively. The role of the government is certainly important in maintaining the rhythm of this development efficiency. But unfortunately, development activities that are currently occurring in various provinces show a pattern that is still inefficient. The findings in Abduh's (2023) study do show a positive pattern between government intervention through the Special Allocation Fund (DAK) in encouraging the formation of urban areas. However, further investigation of the components of government spending concluded that there is a need for a budget reorientation that focuses more on increasing the economic productivity of each regional government. The illustration is that every one percent increase in the capital expenditure variable, derived from total regional government spending, increases the chances of a province being trapped in the agricultural-based and transforming regions by 17.9% and 4%, respectively. We do not blame the proposals for the construction of grand mosques, city squares, or sports stadiums by various local governments during the annual Musrenbang if they have been carried out through a participatory process. However, the government also needs to find ways, even take risks, to accumulate these annual funds for purposes that are more long-term and have a broad impact on the local economy and their region.

The most visible imbalance in regional development is the phenomenon of investment inequality centered in urban areas, the majority of which are on the island of Java. Economic growth that tends to be saturated in Java continues to be followed by the concentration of investment in it. Total investment in Java in 2018-2019 averaged 54.42% of the total investment in Indonesia per year. Jakarta's share of investment exceeded 20%. This concentration of investment is not without reason. Java is the center of human activity in

Indonesia, so consumption/market activities are mostly on this island. The high level of human activity is increasing daily, while efforts to revive economic activity outside this island appear to be stagnant. This is especially true in the eastern region of Indonesia, most of which falls into the category of agricultural-based areas.

Figure 20: Distribution of National Railway Lines 2023

Source: *Openrailwaymap.org*

Active railway lines may support anecdotal statements about the lack of development outside Java. For example, based on the results of a search of IRIO data elements, it shows that in all agriculture-based areas, not a single province has contributed input to the rail transportation subsector. This is as shown in the screenshot from the Openrailwaymap.org site (figure 20), which shows the absence of railway lines in non-Java areas. This condition will certainly hinder mobility and large-scale economic interaction outside Java. Therefore, it is expected that this situation will negatively affect efficiency and the added value in non-urban areas.

Product and regional development strategies should pay attention to aspects of input excellence in encouraging the multiplication of economic output. Such attention is related to the development of high-value activities (non-subsidized) to offset changes in prices and consumption patterns, mapping pockets of staple food production and leading commodities whose results aim to increase the income of the poor, encouraging the provision of non-agricultural jobs (off-farm) to accommodate potential workers who move to rapidly growing economic sectors, and providing infrastructure that supports various development orientations (Byerlee, Janvry, Klytchnikova, Sadoulet, & Townsend, 2008). One of the highlights of this transformation effort is that the education system should be integrated to provide a workforce that meets the needs of industries in various provinces and sectors.

In this study, education is described as a sector that has the lowest level of inequality in terms of output (economy) compared to other sectors. This concludes at least two things. First, the output of education has relatively the same standards across provinces. This means that the capacity of students produced to meet the needs of industry is relatively the same across regions. However, at the same time, this picture shows that the ability of these students to meet the needs of industry with diverse qualifications is still low. This condition indicates a mismatch between the education sector and the industrial sector, which results in a counterproductive relationship between the output of education produced by the ideals of the expected economic transformation. If reflected on the results of Abduh's (2023) previous study, it shows that the length of education taken by the students are still not positively correlated with driving transformation towards high-income areas with low levels of education. The data shows that a one percent increase in the average years of schooling for the population raises the likelihood of a province being stuck in agricultural-based areas and areas in transition by 23.1% and 5.2%, respectively.

Cross-sector collaboration is necessary. Fiscal capacity is a limitation that must be taken into account when creating stimulus tailored to the advantages of various sectors and regions. This study has simulated the economic impact of several levels of input development priorities. Economic sector interventions should begin with leading inputs. Furthermore, it is continued to input that is oriented forward before the selection backward. We assume that the orientation in downstream sectors can have a trickle-down effect on upstream industries. The selection of interventions in other than these leading sectors (leading forward, leading backward, or not leading) is carried out when there is excess fiscal capacity after the leading sectors have been fully intervened.

VI. Conclusion

This study classifies provinces into four categories, which include 8 agriculture-based regions, 3 type A transforming regions, 12 type B transforming regions, and 11 urban regions. Not all sectors have activities in each province. In terms of territory, no province could provide complete input (52 sub-sectors) in producing various types of output. In general, the Eastern Indonesia Region is the province with the fewest types of input provisions. Furthermore, none of the provinces in these agriculture-based regions contribute any input from the rail transportation sub-sector.

In terms of territory, not all sectors have activities in various provinces and sectors (or their technical and Leontief coefficients are zero). In contrast, the coefficients in all provinces and sectors display a wide range of values, indicating significant inequality. Meanwhile, according to the sectoral distribution, Table 4 specifically explains that the hunting subsector/very traditional sector tends to have been abandoned in various regions, even though these regions are still trapped in agricultural poverty. This has an impact on low added value.

The high inequality of indices on the input side shows a diverse pattern of input absorption in each province, while on the output side it shows the production capacity of various outputs whose scale is relatively limited and similar in each province. This condition shows that the economic character between provinces in the same region is very diverse. Although the character of rural poverty and the structure of the agricultural economy are similar, the interaction of economic inputs is diverse.

The diversity is explained in more detail with the diversity that is also formed at the level of smaller classes. Urban and transforming areas—A have a correlation that tends to be positive between the decile class level and the number of elements in it. More specifically, at the transformative area level, it forms a distribution pattern of the number of elements that are positively correlated (for urban and transforming areas A) and negatively correlated (for agricultural-based and transforming areas B). Coefficient A shows the contribution of inputs to its output, while decile shows the ranking of the value of coefficient A. The positive correlation for Urban and Transform A shows that the average input from this area tends to be used for the main input in the production process of various outputs. Although the negative correlation for Agricultural-Based and Transforming B shows that the average input from this area tends to be used for complementary input in the production process of various outputs.

Meanwhile, the Gini index value in each sector is almost perfect on both the input and output sides, as shown in Table 7. What sets the inequality index apart is that, for inputs, the average value in different agricultural sub-sectors is generally lower than in other sectors. While on the output side, the average value of the inequality index in the service sector is lower than other sectors. The low inequality index in the agricultural sector on the input side indicates the concentration of various elements in this sector, which is caused by the low added value of the sector. Conversely, the relatively higher demand for various service sub-sectors in several urban areas positively affects the low inequality index of the sector on the output side, which results from a decrease in the standard deviation within those regions.

The distribution pattern of the Leontief coefficient, elementally, has high inequality and distribution. The pattern of the decile distribution is almost the same as the distribution of the technical input coefficient (A), especially when viewed from the curve of the ratio of the average value (mean) to the standard deviation value. While in the deciles, the input elements that dominate in the agricultural-based, transforming type A, and type B regions come from the service sector. While in the urban region, it comes from the agricultural sector. The study also tried to group input elements based on the level of output multiplication in each sector in various regions. The analysis is done to see if the ability to multiply output in various sectors has a pattern that arises from the type of sector itself, as well as from the region where the sector is located.

The classification results show that there are 167 types of leading inputs, which make up 10.1% of the total inputs, where both the Backward Linkage Index (IKB) and Forward Linkage Index (IKD) are above 1. Among the 167 leading inputs, none come from the agricultural sector. This is in contrast to the existence of activities in this sector in all provinces (except DKI Jakarta). This shows the strong characteristics of agricultural subsistence carried out in all regions. Meanwhile, leading inputs from the mining, manufacturing, and service sectors are 5, 119, and 43 units, respectively.

This study also calculates the potential for economic multiplication of stimulus given to various types of input. In general, when we simulate the average effect on Gross Domestic Product (GDP) from each Rp1 trillion input, it results in an impact of about Rp932.4877 billion, which includes around Rp588.2964 billion as a direct effect. The remaining Rp344.1913 billion is an indirect impact from the multiplication of other sectors in the province and from various sectors in other provinces. In terms of labor compensation, the average overall multiplication caused by each increase in final demand stimulus is Rp360.5 billion, or on average equivalent to the creation of 128.3 thousand jobs. On average, the realized potential for export multiplication amounts to Rp137.2 billion, with 59.52% direct impact and 40.48% indirect impact. The impact on imports is an increase of Rp67.5 billion on average. The overall average tax multiplication (after deducting subsidies) is IDR 25.0 billion per province.

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