Analysis of Input-Output Table : Integrated of Economic Development by Leading Sectors in Indonesia

NUGROHO***, Yoga, D[1]; MURTI, Sartika, A[2]

[1] Badan Pusat Statistik (BPS - Statistics Indonesia)
[2] Badan Pusat Statistik (BPS - Statistics Indonesia)

Abstract:

The economic development of a country includes the overall development of both natural and human resources. The indicator that illustrates Indonesia's economic conditions is GDP (Gross Domestic Products). In fact, GDP only shows a sector's share of the total and cannot describe the actual conditions, and cannot explain the sector's interrelationship and the leading sectors in GDP. Therefore, Indonesia unable to optimize the leading sector in the economic development process, so a comprehensive analysis method is needed such as the Input-Output Table analysis. The Input-Output table presents information on the transaction of goods and services in production activities, the final demand from supply components, and gross value added. The aim of this study will analyze the leading sectors through backward and forward linkage and explain the economic driving sector (multiplier effect) through output, income, employment, and value-added multiplier. Analysis of the input-output table shows that 2 out of 17 sectors are leading sectors with the value of forward linkage and backward linkage more than 1, namely, the manufacturing industry and the procurement of electricity, gas. The analysis using multiplier effect analysis shows the sectors with the greatest multiplier output are the procurement of electricity, gas and the lowest are agriculture, forestry, and fisheries. The sector with the greatest income multiplier is the procurement of electricity, gas while the sector with the lowest income multiplier is government administration, defense, and mandatory social security. The sector with the greatest employment and value-added multiplier effect is the procurement of electricity, gas sector. Based on the results of the analysis, the policy recommendations that can be taken by the government concerning economic development is optimize the potential of the manufacturing industry sector and the procurement of electricity, gas as a national priority.

Keywords: Structure of I-O Table; Forward Linkage; Backward Linkage; Multiplier Analysis

1. Introduction:

According to Dunford (2009) explains that in Neoclassical Economic Theory, regional economic development depends on the availability of resources, which are a series of activities that originate in humans, capital accumulation, use of modern technology, and output. The main key to the neoclassical development model is the aggregate of the production function. Maximizing the production function in economic development means maximizing all available resources. The interaction of all resources in the economic system is explained by Barbier (2003) where K_n as natural capital, K_p as physical capital, and K_h as human capital (Figure 1) play a role in the production process that leads to human welfare. Physical capital has a role as a built environment and natural capital as aesthetic life support. On the other side human capital as a labor in the production process also the source of human knowledge that supports welfare.

Indonesia is a big country that consist of 17.000 islands, including Sumatera, Java, Kalimantan, Sulawesi and Papua Island. With over 267 million people, it is the world's 4th most populous country. Because of this condition Indonesia needs complex and comprehensive policy to maximize the resources (physical, natural and human capital) in the economic development process according to some indicators. Meanwhile, to find out the success of the economic development process needs the right and comprehensive indicators. The indicator can reflect, illustrate, and control the economic process. The common indicator used by all countries is GDP (Gross Domestic Products). In fact, GDP only shows a sector's share of the total and cannot describe the actual conditions, and cannot explain the sector's interrelationship and the leading sectors in GDP. Therefore, Indonesia unable to optimize the leading sector in the economic development process, so a comprehensive analysis method is

needed such as the Input-Output Table analysis. The Input-Output table presents information on the transaction of goods and services in production activities, the final demand from supply components, and gross value added. BPS-Statist

The aim of this study will analyze the leading sectors through backward and forward linkage and explain the economic driving sector (multiplier effect) through output, income, employment, and value-added multiplier.
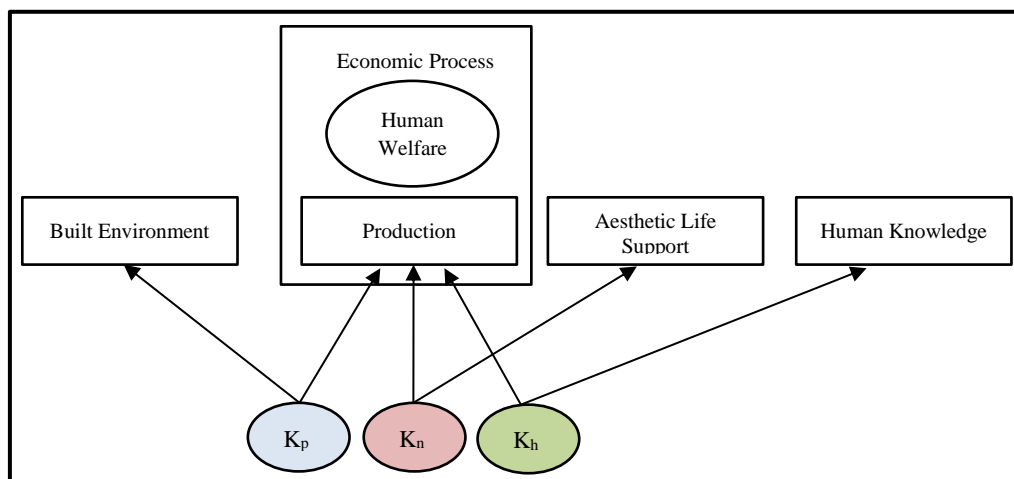

Figure 1. K_P, K_n and K_h in an economic system

2. Methodology:

Input-Output (I-O) Table Structure

Input-Output analysis as a theoretical framework and an applied economic tool in a market economy was developed by Wassily Leontief with the construction of the first input-output tables for the United States for the years 1919 and 1929 which were published in 1936 (UN, 1999). The Input-Output table shows output structure, value added, intermediate consumption, supply and demand between sectors. Input-Output analysis can predict the impact of economic change between final demand and output total, value added, import, tax, and labor force. It can also explain the leading sector and the impact between other sectors (Figure 2).

BPS-Statistics (2015) stated the use of I-O tables are:

a) Knowing the composition between supply and use of goods and services, especially in the analysis of import requirements and possible substitutions
b) To find out which sectors have the most dominant influence on economic growth and sectors that are sensitive to national/regional economic growth
c) Estimating the impact of final demand on output, value added, imports, tax revenues and employment in various production sectors
d) Arranging the projections and evaluations of macroeconomic variables.

Forward and Backward Linkage

Forward Linkage describes how an increase in output of certain sectors will encourage an increase in the output of other sectors. This linkage analysis indicates how to use the input as intermediate consumption and focused on input structure. Backward Linkage describes an increase in the output of a certain sector will increase the input demands of other sectors and focused on demand structure.

$$IFL_i = \frac{\sum_{j=1}^n b_{ij}}{\sum_{i=1}^n \sum_{j=1}^n b_{ij}} \, n \qquad IBL_j = \frac{\sum_{i=1}^n b_{ij}}{\sum_{i=1}^n \sum_{j=1}^n b_{ij}} \, n$$

Where,

IFL_i : Index of forward linkage of i sector

b_{ij} : elements of invers Leontief matrix for row i and column j

n : number of sectors

i : number of sectors in input structure and index of row in matrix

IBL_j : Index of backward linkage of j sector   j   : number of sectors in demand structure and index of column in matrix
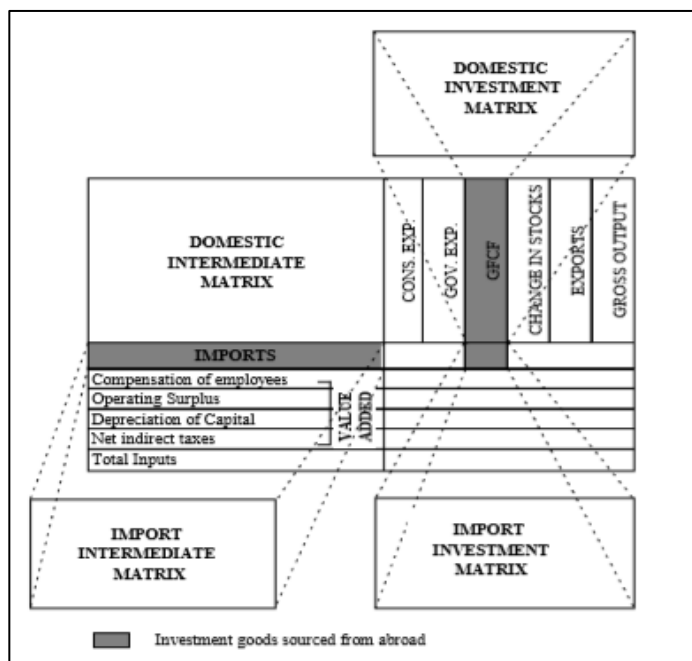
Source : OECD, 1991
Figure 2. Structure of I-O Table

Multiplier Analysis

Multipliers measure the total effects on either output, income, employment or value added, given an increase in one unit of output of a particularly industry (UN, 1999). Measuring the multiplier, we have an equation to calculate the output value :

$$\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{Y}$$

Where, $(\mathbf{I} - \mathbf{A})^{-1}$ is inverse of Leontief Matrix, and X, Y denoted as output and final demand.

The formula of several multiplier are below :

Output Multiplier	Income Multiplier	Labor Multiplier	Value Added Multiplier
$\Delta X = (I - A)^{-1}\Delta Y$ With $\Delta Y = I$, so: $O_j = \sum_{i=1}^{n} b_{ij}$	$I_j = \sum_{i=1}^{n} a_{n+1,i} b_{ij}$ Where, $a_{n+1,i}$ as the ratio between wage and total input	$L_j = \sum_{i=1}^{n} w_{n+1,i} b_{ij}$ Where, $w_{n+1,i}$ as the ratio between labor and total output	$V_j = \sum_{i=1}^{n} v_{n+1,i} b_{ij}$ Where, $v_{n+1,i}$ as the ratio between value added and total output

Output Multiplier describes output change in the certain sector because of the output change of other sectors. Income Multiplier describes output change in the certain sector because of the income change of other sectors. Labor multiplier shows the relationship between labor output is the amount of labor required to produce one unit of output. Meanwhile, the value added multiplier reflects the influence of each component of the final demand for creating value added in each sector.

3.   Result:
Structure of Input-Output (I-O) Table

Explanation of the structure of I-O Table Indonesia on 2010 include intermediate input, value added and output of each sectors. The explanation shown by Table 1 (billion rupiah).

Table 1. Intermediate input, value added, and output of 17 Sectors, I-O Table 2010

Sectors	1	2	3	4	5	6	7	8	9
Intermediate Input	209,193	251,270	2,818,165	237,002	4,144	1,130,851	442,862	307,309	240,999
Value Added	978,787	690,047	1,552,652	72,491	19,669	593,452	927,109	243,579	199,130
Output	1,187,980	941,317	4,370,817	309,493	23,813	1,724,303	1,369,971	550,888	440,130

Sectors	10	11	12	13	14	15	16	17	
Intermediate Input	154,074	92,004	42,652	83,163	158,843	109,645	82,806	60,458	*The explanation of sectors code stated in figure 3
Value Added	254,993	241,053	203,656	119,808	259,646	201,566	66,509	59,532	
Output	409,068	333,057	246,308	202,972	418,489	311,211	149,315	119,990	

Reviewed from three aspects, intermediate input, value added and output shows that the third sector named Manufacturing Industry contributes the highest share and fifth sector named as Water Supply, Waste Management, Waste, and Recycling contribute the lowest share. It can be described that manufacturing industry need another sector to supply their input especially intermediate input and the change of this sector in the whole aspects such as output, input, or income can encourage the change of another sectors. It indicates that the multiplier effect and sector linkage between the manufacturing industry and another sector is higher in total. On the other side, the manufacturing industry also gives the highest share for GDP as a whole economy and give a significant impact for another sector if there is a change in its aspect. Input-Output analysis always maintains the assumption that input and output are balanced so output in this table can be also called total input. So, the Manufacturing industry needs the greatest input than other sectors that shows how big this sector can produce.

Forward and Backward Linkage

The Corona Virus (COVID-19) that affects the global economy also brings a big impact to all the sectors. From this condition, to run the comprehensive and integrated economic development process we can use forward linkage (IFL) and backward linkage (IBL) analysis. In this analysis, we can know the sectors that sensitive to the change of final demand also sectors (IFL > 1) that has leverage power to the economic process (IBL > 1).

Figure 3 shows that the sectors may reactive/sensitive to the change of final demand reflect by quadrants I and II. There are 4 (sector 1, 2, 3, and 4) out of 17 sectors which include to this quadrant. This sectors labelled as a more sensitive sector because the decreasing of final demand will decrease the production and the input demand from this sector relatively more decreasing compared with other sectors. The manufacturing industry has the highest forward linkage index with 4.09. This value has meaning if final demand decreasing by 1 million rupiahs then the output of the manufacturing industry will be allocated to other sectors and this sector also decreasing by 4.09 million rupiahs. In other words, an increase of output in the manufacturing industry can encourage the increase of output in another sector especially sector that use as intermediate consumption in the manufacturing industry.

Meanwhile, the potential sector as recover (has leverage power) economic activity reflects by quadrants I and IV. There are 7 (sector 3,4,6,8,9,16 and 17) out of 17 sectors which include this quadrant. This sector has leverage power because the increasing of final demand of these sectors will increase the production, input demand from other sectors will increase. So, the output of another sector will also increase and in the end the economic activity also increasing. The electricity and gas supply sector has the highest backward linkage index with 1.57. This value means that if the final demand for this sector is increasing by 1 million rupiahs, then the input demand of this sector against other sectors will increase by 1.57 million rupiahs. Actually, electricity and gas supply used by another sector as the one of the fixed input that must be fulfilled. In other words, if there is a decrease or deficit in this sector can impact the significant problem in the production process of another sector.

So, from the IFL and IBL value, the leading sector is a sector that has IFL > 1 and IBL > 1 or sector that includes in quadrant 1. There are 2 sectors that include in this quadrant, sector 3 labelled as the manufacturing industry and sector 4 labelled as electricity and gas supply. The leading sector means a potential sector that needs to be improved because play an important role in the economic activity in Indonesia especially.
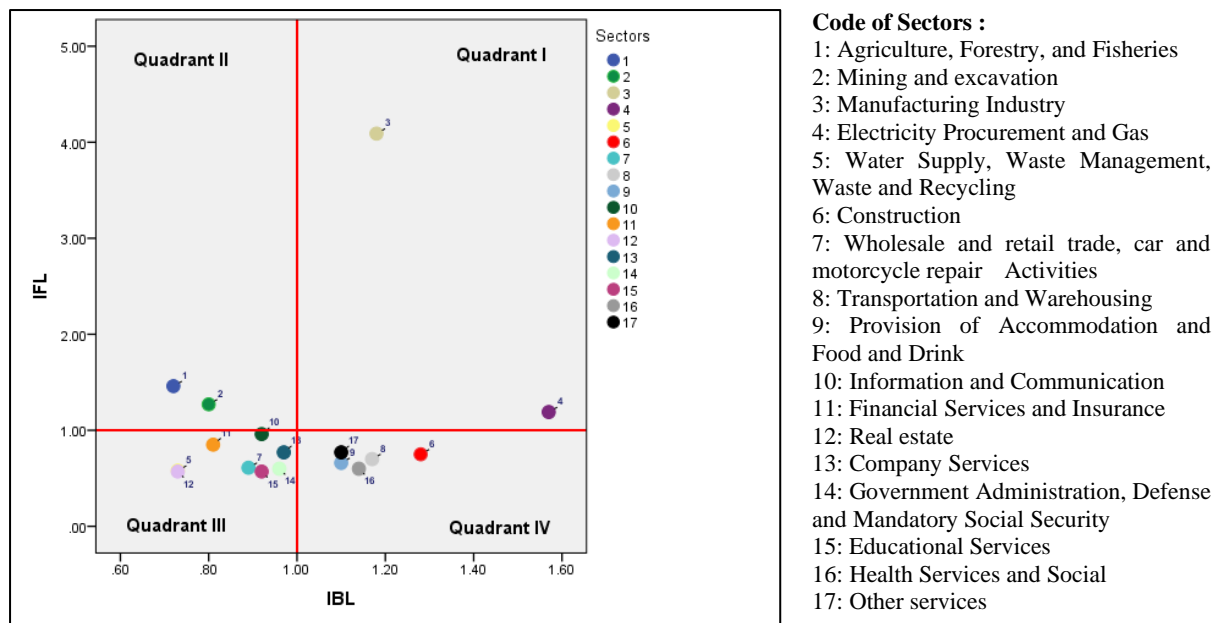

Code of Sectors :
1: Agriculture, Forestry, and Fisheries
2: Mining and excavation
3: Manufacturing Industry
4: Electricity Procurement and Gas
5: Water Supply, Waste Management, Waste and Recycling
6: Construction
7: Wholesale and retail trade, car and motorcycle repair   Activities
8: Transportation and Warehousing
9: Provision of Accommodation and Food and Drink
10: Information and Communication
11: Financial Services and Insurance
12: Real estate
13: Company Services
14: Government Administration, Defense and Mandatory Social Security
15: Educational Services
16: Health Services and Social
17: Other services

Figure 3. Quadrant Analysis of IFL and IBL, Table I-O 2010

Multiplier Analysis

Analysis of leading sectors will use analysis that is often used, namely, analytical tools that can explain a sector as a unit that gives influence to the economy through multiplier analysis (Hidayat and Suahasil, 2005). Multiplier analysis that conducts in this study includes output, income, labor, and value added multiplier. Output multiplier shows increasing in output in all sectors caused by the increase in final demand by one unit in a particular sector. Table 2, shows us sector with the greatest multiplier output are the procurement of electricity, gas (sector 4), and the lowest are agriculture, forestry, and fisheries (sector 1). The output multiplier output of sector 4 is 2.92, which means that if the final demand of procurement of electricity, gas increasing by 1 million rupiahs then the output of all economy sectors also increases by 2.92 million rupiahs.

Furthermore, the income multiplier describes the amount of creating income caused by the change of final demand in a certain sector. Table 2 shows that the greatest income multiplier is the procurement of electricity, gas (sector 4) while the sector with the lowest income multiplier is government administration, defense and mandatory social security also education services (sector 14 and 15). The income multiplier output of sector 4 is 4.17, which means that if the final demand of procurement of electricity, gas increasing by 1 million rupiahs then the income of another sector also increases by 4.17 million rupiahs. Moreover, the labor multiplier explains that there is a proportional relationship between the output provided and the amount of labor used. If we ask for additional output to be needed, we can also calculate the amount of labor needed. The greatest labor multiplier is the procurement of electricity, gas (sector 4) with 12.70. It has means that if the final demand for procurement of electricity, gas increasing by 1 million rupiahs then the employment (absorption of labor) of another sector also increases by 12-13 people.

On the other side, the value added multiplier describes the amount of creating value added caused by the change of final demand in a certain sector. The greatest of value added multiplier is the procurement of electricity, gas (sector 4) with 4.27. It has means that that if the final demand of procurement of electricity, gas sector increasing by 1 million rupiahs then the value added of all economy sectors also increases by 4.27 million rupiahs. In line with linkage analysis, the result of

multiplier analysis shows that the manufacturing industry and procurement of electricity, gas sector are the leading sectors and most potential sectors to support the economic development of Indonesia.

Table 2. Result of Forward and Backward Linkage, Multiplier Analysis

Sectors	IFL	IBL	Oj	Ij	Lj	Vj
1	1.46	0.72	1.33	1.24	1.11	1.21
2	1.27	0.80	1.49	1.57	2.69	1.36
3	4.09	1.18	2.20	2.54	4.50	2.82
4	1.19	1.57	2.92	4.17	12.70	4.27
5	0.58	0.73	1.36	1.47	1.29	1.21
6	0.75	1.28	2.37	2.30	3.69	2.91
7	0.61	0.89	1.65	1.46	1.29	1.48
8	0.70	1.17	2.18	2.02	2.00	2.26
9	0.66	1.10	2.04	1.94	2.48	2.21
10	0.96	0.92	1.72	1.68	3.72	1.60
11	0.85	0.81	1.51	1.39	1.75	1.38
12	0.57	0.73	1.36	2.22	3.88	1.21
13	0.77	0.97	1.80	1.66	1.88	1.69
14	0.60	0.96	1.77	1.21	1.63	1.61
15	0.57	0.92	1.72	1.21	1.32	1.54
16	0.60	1.14	2.13	1.73	2.30	2.25
17	0.77	1.10	2.04	1.70	1.51	2.02

4. Discussion, Conclusion and Recommendations:

From the explanation of research result above, the conclusion of this research are manufacturing industry (sector 3) and procurement of electricity, gas sector (sector 4) are the leading sectors and most potential sector to support the economic development of Indonesia. Moreover, both sectors according to the result of forward linkage (IFL) and backward linkage (IBL) have the greatest value compare to another sector. In line with linkage analysis, multiplier analysis from 4 different approaches shows that both sectors also have the greatest value.

Also, the suggestions of this study are the government should pay attention to the manufacturing industry from intermediate consumption sight. The government can increase output of the manufacturing industry by give subsidy or decrease the tax or government can decrease the price of another sector that be the intermediate sector for manufacturing industry by giving subsidy. This method can increase the output of manufacturing industry that also increase output of another sector. Furthermore, the government should pay attention to electricity and gas supply from input demand sight. The government can decrease the price of this sector by giving the subsidy so other sectors can give higher value added for GDP share.

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