

## INPUT-OUTPUT ANALYSIS: A CASE STUDY OF TRANSPORTATION SECTOR IN INDONESIA

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### ABSTRACT

*This study Aimed to analyze the transport linkages and multiplier effects of each subsector of transport when there is a change in the budget of the transport sector in the Indonesian economy. This study uses an analytical tool input - output models of Indonesia in 2010, with 185 sectors. Input - output models is used to analyze the relationship backwards and forwards in the transport sector of the Indonesian economy and the multiplier effect on the Indonesian economy as a whole. Results of the analysis Showed that the transport has a total backward linkage high while total forward linkage of transport is relatively low. This is an indication that transportation plays in attracting and developing the upstream sector, but less instrumental in developing the downstream sector. The results Obtained from the analysis of the output multiplier effect when a decline in the transport sector budget has a high value, while the income multiplier and labor multiplier when a decline in the transport sector budget has a low value. This shows a Decrease in the budget in the transport sector can reduce the production output of the Indonesian economy but less budget reduction effect on income and employment.*

**Keywords:** Transportation, input-output, linkage forward, backward linkages, multiplier effects

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### Introduction

Indonesia is the largest archipelago country in the world that Consist 13 466 islands and is the fourth most populous country in the world with a total population of approximately 258 million people or about 3.5% of the total World Population. With a high population the higher activities undertaken by the community and needed her more in the mode of transportation for fulfillment.

Gross Domestic Product (GDP) 2014 National Indonesia cumulative growth of 5.06%. Of all sectors, the third sector is the biggest contributor to economic improvement of the trans-

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port and communications sector which amounted to 9.31%, the construction sector amounted to 6.58%, and financial services, leasing and corporate services amounted to 5.96%. This shows that the transport and communications sector is vital to the growth of national economy.

**Table 1: The growth rate of Gross Domestic Product by Industrial Origin at Constant Prices (percent), 2014**

Business field	2014
1. Agriculture, Livestock, Forestry, and Fishery	3:02
2. Mining and excavation	-
3. Processing Industry	4.8
4. Electricity, Gas, and Water	5:05
5. Building	6:05
6. Trade, hotels, dan Restaurant	4.6
7. Transportation and Communication	9:03
8. Finance, Real Estate, Corporate and Services	5.9
9. Offices	5.9

Source: BPS, 2015

Growth in the transport sector will reflect the direct economic growth so that transport has an important and strategic role, both macro and micro. The success of the transport sector in macro can be seen from the contribution of value added in the formation of the Gross Domestic Product (GDP), the impact multiplier (multiplier effect) that causes to the growth of other sectors and the ability to reduce the rate of inflation through the smooth distribution of goods and services to the entire country.

Given the activities in the field of transportation plays an important role in the distribution of goods and services to the entire country and between countries, so transport is a strategic component in equity and economic growth, the flow of the movement of people and goods, the flow of information (flow of information), funds flow (flow of finance) which needs to be managed quickly and accurately to meet the demands punctuality. Transportation is also a means of prosperity, political development, social security and defense culture. The role of transport as a 'bridge' that facilitate all economic activities and national logistics, provide social and economic value added (Increased economic social values) (Silondae, 2016).

Fluency in economic activity, especially in the distribution of a wide range of supported output modes of transport can extend their reach in the economic activity of a region. Will indirectly create new jobs thus increasing the absorption amount of labor and reduce the number of unemployed in Indonesia. The increasing number of labor and faster distribution of the output is by itself will increase incomes and local levels. Thereby indicating that the corresponding relationships with the transport sector in economic activities is very great because almost all economic activities require the support of the transport sector for the smooth process of production, distribution, and consumption.

Construction of transportation infrastructure can open up the accessibility thereby increasing the production of society that led to the increased purchasing power of community. Transportation within the scope of transportation economics is essential to meet the transportation needs are constantly increasing in line with population growth, economic growth require the development of roads, terminals, ports, the setting and the means to support a transportation system that is efficient, safe and smooth and environmentally sound. Efficient

transport system is used as a reference understood better economic considerations investment transportation infrastructure.

Thus, this study aimed to analyze the relationship between transport sector land, sea, and air that affect the economy in Indonesia include the linkage forward (forward linkage) and backward linkages (backward linkage) transportation sector to other sectors, and calculate the multiplier effect output, income, and labor when there is a change in the budget of the transport sector in Indonesia by using the statistical approach of input-output (IO).

## Theoretical Basis

### *Transportation*

Transport defined as the transfer of goods and people from origin point to destination point. Transporting process is a movement from the place of origin, from which the transport activities begin, the place of destination, where the transport ends. Transportation causes a higher value of goods at the destination of the place of origin. Value or usefulness given by transport such usefulness place (place utility) and the use of time (time utility) (Nasution, 2004).

Transport is part of the economic activity associated with increasing one's satisfaction with the change in the geographic location of goods or people. This bias means moving raw materials to a place where the material can be manufactured more easily, or moving to finished goods to the place where the goods can be useful for consumers. Moreover, transportation is also biased to bring consumers a place where they are biased enjoy the services provided (Benson, 1975).

Transportation is an activity services (service activities). Transportation services needed to assist the other sector-sectors (agriculture, industry, mining, trade, construction, financial sector, the government sector, transmigration, defense and security, and others) to transport goods and people in the activity at each respective sector. Based on the explanation, the transportation service is said to be derived demand or demand on derivation or derivative, which means increased demand for transportation services necessary to serve a wide range of economic activities and development increased. Increased demand for transportation services is derived from the increase in activities of other sectors (Siregar, 1995; in Adisasmita, 2010).

Kamaluddin (2003) argue that the transport associated with economic and socio-economic state and society because it affects the availability of goods in the region, stability and uniformity of prices, falling prices, rising land values, specialization between regions, the development of large-scale enterprises and the urbanization and population concentration. The presence of cheap transport provide convenience to people who are not able to produce certain goods or their availability in deprivation can be supplied the goods from the producing areas to meet the needs of the communities concerned.

The transport sector provides a multiplier effect for other economic sectors such as trade, industry, agriculture, tourism and transport sectors, biased lainnya. Sektor other sectors into growing and contribute substantially to the economic growth of Indonesia, causing trickling-down effect from upstream to downstream. Availability of transportation services is positively correlated with economic activity and development in the community (Setyowati, 2015).

## **Theory of Production**

Nicholson (2008) explains that the production function is a mathematical function that shows the relationship between the inputs used to produce a given level of output. Systematically production functions are  $Q = F(K, L, R, T)$ , where Q is output, K is capital, L is labor, R is resource, and T is technology.

This equation relates the output of a number of inputs, capital, labor, resources, and technology. Describe the production function is technically a company in the production process as efficiently as possible in using any combination of input that is as effective as possible and allow the production factor inputs to be combined in a variety of options, so the output can be produced in various ways. Production economics theory of analysis to distinguish between the two approaches, as follows:

### a) Production with one variable input (labor)

Sukirno (2013) describes the production of a simple theory is the relationship between the level of production of goods to the amount of labor used to produce different levels of the production of such goods. In the analysis, let us assume that other production factors are fixed, namely capital, land, and technology deemed unchanged amount. The only factor of production that can be changed is the amount of labor.

### b) Production with two variable inputs (labor and capital)

Isoquant curve shows a combination of two kinds of different inputs but produces the same output. Isoquant curve has several characteristics that is negatively sloped, getting to the right position isoquant curve indicates the higher number of outputs, isoquant curves never intersect with other isoquant curve and isoquant curves are convex to the origin point (Munir, 2008).

Pindyck (2001) describes an enterprise in the production process using two input and two varied. Labor and capital as inputs used in the production process. Isoquant is a curve that shows the possible combinations of inputs produce the same output.

## **Input-Output Model**

Nazara (2005), Mukiyono et al. (2017) describes input-output analysis is a general equilibrium analysis equipment. Balance in input-output analysis is based flow of transactions between economic agents. The main emphasis in input-output analysis is on the production side. The production technology used by the economy plays an important role, because of the technology in relation to the use of intermediate inputs. To a certain extent, the primary input is regarded as an exogenous variable, as well as the final demand side is also often used as an endogenous variable.

According to BPS (2015) data presented in the table IO is a detailed information about the inputs and outputs of sectoral able to describe the linkages between sectors in economic activities. In accordance with the basic assumptions used in the preparation process, input-output models are static and open. IO table presents information about goods and services transactions that occur between economic sectors with the form of presentation in the form of a matrix. Fields along the lines of the IO table shows the allocation of the output generated by the sector to meet the demand for intermediate and final demand. In addition, the stuffing on the line show the added value of sectoral composition of value creation. While the stuffing along the columns show the structure of the inputs used by each sector in the production process.

The usefulness of input-output table is the first to look at the composition of the supply and use of goods and services, especially in the analysis of the needs and possibilities of import substitution. Second, to determine which sectors more dominant influence on economic growth and sectors are sensitive to economic growth of national / regional. Third, to estimate the effect of final demand on output, value added, imports, tax revenues, and employment in various sectors of production. Fourth, for preparation of a projection and evaluation of macro economic variables (CBS, 2015).

## Research Methods

The study was conducted using a quantitative approach by using Input-Output model analysis. Input-Output Model used to determine the transport sector linkages with other economic sectors in the national economy and quantify the impact of budget changes to the transportation sector to the economy's output, income and employment communities in Indonesia. In 2016 the total budget the Ministry of Transportation of Rp 48.46 trillion. While in 2017 the total budget of the Ministry of Transportation amounted to 45.58 trillion, resulting in a decrease of Rp 2.88 trillion. So the scenario that developed is a decline in the transport sector budget at Rp 2.88 trillion in the transport sector.

Between Input proportion coming from the transport sector (sector i) of the total input of other sectors (sectors j) is called the Input Coefficient Between obtained by the formula:

$$a_{ij} = \frac{x_{ij}}{X_j} \quad (1)$$

$$x_{ij} = a_{ij} X_j \quad (2)$$

Where  $a_{ij}$  is coefficient input transport sector (subsector j) of the other sectors (subsectors i),  $x_{ij}$  is user input by the transport sector (subsector j) of the other sectors (subsectors i), and  $X_j$  is output transport sector (subsector j).

### Linkage Analysis Between Sectors

#### a. Rear linkage (Backward Linkage)

The size of the rear linkage to the transport sector (subsector j) can be seen from the number of input coefficients between the transportation sectors (subsector j) or the number of elements in the row matrix A j. Index backward linkages obtained by the formula:

$$IKBL_j = \frac{n \sum_{i=1}^n a_{ij}}{\sum_{i=1}^n \sum_{i=1}^n a_{ij}} \quad (3)$$

Where  $IKBL_j$  is rear linkage index transport sector (subsector j);  $a_{ij}$  is coefficient of input between transport sector (subsector j) derived from other sectors (subsectors i); n is number of sectors.

#### b. Linkage to the Future

The level of forward linkages to other sectors (subsectors i) can be seen from the number of input coefficient values between the in-line with other sectors (subsectors i) the number of elements in the row matrix A i. Straight forward linkage index i sector is obtained by the formula:

$$IKBL_i = \frac{n \sum_{j=1}^n a_{ij}}{\sum_{i=1}^n \sum_{i=1}^n a_{ij}} \quad (4)$$

Where  $IKBL_i$  is index forward linkages to other sectors (subsectors i);  $a_{ij}$  is coefficient of input between transport sector (subsector j) derived from other sectors (subsectors i); and n is

number of sectors.

### **Multiplier Impact Analysis**

#### **1. Analysis of Output Multiplier**

To analyze the impact of changes in transportation budget to the output of the input-output model is used with a supply side approach. In this analysis the primary input into exogenous factors. That is the primary input changes affect the economic growth of both sectoral and total. The equation calculates the coefficient input as follows:

$$a_{ij} = \frac{z_{ij}}{X_j} \tag{5}$$

Then unloaded and get results:

$$X' = V(I - A) - 1 \tag{6}$$

Where is  $X$  is vector line;  $(I - A) - 1$  is matrix inverse output;  $V$  is vector of final demand If the budget is denoted (a), then the output changes caused as a result of changes in (a) are:

$$\Delta X' = a\Delta(I - A) - 1 \tag{7}$$

#### **2. Analysis of Income Multiplier**

Household income figures show the transport sector which changes the amount of income received by households that are created due to changes in the budget in the transport sector. The first thing done is to develop a matrix coefficient of income, calculated with the following formula:

$$n_i = \frac{W_i}{X_j} \tag{8}$$

Where  $n_i$  is coefficient of income;  $W_i$  is total revenue sectoral;  $X_j$  = total sectoral output. When it is known coefficient of earnings, then the change in income can be calculated using the equation:

$$\Delta W_i = n_i X_j \tag{9}$$

Where  $\Delta W_i$  is additional revenue;  $n_i$  is coefficient of income; and  $X_j$  is additional sectoral output.

#### **3. Analysis of Labor Multiplier**

Analysis of Changes in Employment Opportunity input changes occur because of changes in the budget, will result in a change in total inputs, directly or indirectly, the change in total output would lead to changes in final demand. Changes in final demand due to changes in output due to changes in the budget which led to changes in employment, the first thing to do is to draw up labor coefficient matrix. Labor coefficient shows the relationship between labor output is the amount of labor required to produce one unit of output, mathematically can be written:

$$n_l = \frac{L_i}{X_j} \tag{10}$$

Where  $n_l$  is coefficient of labor;  $L_i$  is Number of sectoral labor;  $X_j$  is total sectoral output. If the coefficient of labor is already known, it can be calculated using the change in employment by the equation

$$\Delta L_i = n_l X_j \tag{11}$$

Where  $\Delta L_i$  is additional employment opportunities;  $n_i$  is coefficient of labor;  $X_j$  is additional sectoral output.

## Results and Discussion

### *Rear linkage and linkage to the Future*

Linkage index consists of forward linkage index (forward linkage) or are calculated based on the degree of sensitivity by the side of the line or output mechanism and index backward linkages (backward linkage) or so-called power deployment are calculated based on the column or input mechanism.

There are two kinds of linkages that is, the direct linkages, and linkages total. Linkage is the sum total of direct relevance and indirect linkages. If the value of the index forward linkages to more than 1, it indicates that the sector has the power thrust against other sectors. Improvement on the output produced will greatly affect the production process of other sectors. However, if the index is less than 1, which means the sector is less able to provide a thrust force in the production process of other sectors. While the sector has a high rear linkage linkage index, giving an indication that the sector has the ability to develop other sectors as a provider of inputs for the purposes of the production activities of the sector.

Table 2 shows that out of 6 sub-sectors of transportation in Indonesia, only five transport subsectors that have an index of high backward linkages or more than one. Subsectors include rail transport subsector; land transport; Sea transport; transport streams, lakes, and deflections; warehousing and transportation support services. This is an indication that the subsectors have the ability to develop other sectors as a provider of inputs for the purposes of the production activities the sector. While air transport subsector provides an indication that the sector does not have ability to develop other sectors as a provider of inputs for the purposes of the production activities of the sector.

**Table 2: Backward Linkage Index Transportation Subsector Indonesia Year 2010**

IO code	Transportation subsector	Backward linkage		Spreading Index	
		Value	Ranked	Value	Ranked
157	Rail transport	1.2490	3	0.6180	6
158	Land transport	1.1509	4	0.8941	3
159	Sea transport	1.3515	2	0.7849	4
160	Transport River, Lake and Crossing	1.0151	5	1.0738	2
161	Air transport	0.9472	6	1.2278	1
162-163	Warehousing and Transportation Support Services	1.7256	1	0.7198	5

Source: BPS 2010 (processed)

Sectors which have a total value of backward linkage is a subsector of the largest warehousing and transportation support services with a rate of 1.7256. The value has no meaning if there is an increase in output by one unit in the subsector warehousing and supporting services transport, then this subsector requires additional input from the subsector warehousing and supporting services, transport and other economic sectors that are used in the production process, including from the subsector warehousing and supporting services transport it alone amounted to 1.7256 units. Then, these figures suggest that by increasing the output of

the subsector warehousing and transportation support services will increase the output of the upstream sector.

Forward linkage index as shown in Table 3 describe the effect of the output produced magnitude of transport subsectors to the formation of inputs to other economic sectors. Figures linkage produced a subsector give meaning, that any additional output in these subsectors, it will increase the overall output of the downstream sector of the value linkages. This can happen due to the increase of the output produced by these subsectors resulted in increased distribution of output that will be used as inputs by other sectors, so that the overall output in the downstream sector will increase.

**Table 3: Linkage Index FutureTransportation Subsector Indonesia Year 2010**

IO code	Transportation subsector	Linkage Index Future		Spreading Index	
		Value	Ranked	Value	Ranked
157	Rail transport	0.57752	3	1.24778	4
158	Land transport	0.71819	1	1.00866	6
159	Sea transport	0.55623	5	1.29618	2
160	Transport River, Lake and Crossing	0.52371	6	1.37186	1
161	Air transport	0.5771	4	1.26262	3
162-163	Warehousing and Transportation Support Services	0.69805	2	1.07966	5

Source: BPS, 2010 (processed)

In Table 3 shows that the highest value of total forward linkage index transport sector is highest in the land transport subsector is equal to 0.7181. This figure means that if there is an increase in the output by one unit then output these subsectors will provide additional output in other sectors amounted to 0.7181 or in other words no additional distributed to other production sectors in the economy, including land transport subsector itself to used in the production process. This shows that the output sub-sectors of land transport is widely consumed and used as inputs for production activities in other production sectors.

Subsector which has an index of total forward link transport sector was lowest for the transport subsector rivers, lakes, and crossing that is equal to 0.5237. Of the six sub-sectors of transport, all sub-sectors do not have a total forward linkage index is more than one. This shows that the transport sector less able to push the downstream sector. While the index sixth deployment transport subsectors has a high value or more than one. Distribution Index is quite important to use to see how much influence the output of the land transport subsector; Sea transport; air transport; rail transport; transport streams, lakes, and defections; freight warehousing and transportation support services to the downstream sectors evenly.

### **Analysis Impact Multiplier**

Analysis multiplier is the main analysis that can be performed by using tables Input-Output to know how the effect of a change in the primary input can affect the output of the economy (output multiplier), household income or society (income multiplier), and employ-

ment (employment multiplier) in the transport sector.

**Table 4: Transportation Sub-sector Multiplier Value in Indonesia in 2010**

No.	Sub-sector transportation	Output	Rank	Income	Rank	TK	Rank
1	Rail transport	3.00786	1	0.8792	1	0.0848	1
2	Land transport	0.34449	2	0.05551	2	0.00458	2
3	Sea transport	-3.54119	6	-0.33099	6	-0.0407	6
4	Transport River, Lake and Crossing	-0.00433	3	-0.00086	3	-3E-05	3
5	Air transport	-1.84557	5	-0.24841	5	-0.0021	5
6	Warehousing and Transportation Support Services	-0.5293	4	-0.10937	4	-0.0055	4

Source: Input-Output Table Indonesia 2010

Based on the analysis table as the impact of changes to the budget 4:11 transport sector, respectively in the subsector land transport of Rp 0.27 trillion, rail transport subsector amounted to Rp 3 trillion, sea transport subsector Rp -3.52 trillion, and air transport subsector Rp -1.8 trillion, would reduce economic output amounting to Rp -4.44205 trillion. This shows that the reduction in the budgets in the transport sector amounted to USD -2.88 trillion will reduce economic output amounting to Rp -4.44205 trillion. In detail the impact that occurs due to a decrease in the budget is the rail transport sub-sectors increased by USD 3.00786 trillion, land transport subsector increased by USD 0.34449 trillion, sea transport subsector decreased by USD -3.54119 trillion, transport subsector rivers, lakes, and crossing increased by USD 0.00433 trillion, air transport subsector decreased by USD -1.84557 trillion, subsector warehousing and transportation support services decreased by USD -0.52930 trillion.

The results in Table 4, following which the income multiplier effect of land transport subsector amounted to 0.05551 value indicates when there are changes in land transport subsector budget of Rp 0.27 trillion then there is a change in people's incomes Indonesia Rp 0.05551 trillion. In the rail transport sub-sectors when there are changes in the budget of Rp 3 trillion then there is a change in people's incomes Indonesia Rp 0.87920 trillion. At sea transport sub-sectors when there are changes in the budget of Rp -3.52 trillion then there is a change in the income of -0.33099 trillion Indonesian society. In the air transport sub-sectors when there are changes in the budget of Rp -1.8 trillion then there is a change in the income of -0.24841 trillion Indonesian society.

With the budget decreases in the transport sector would lead to changes in output. Change in output will cause changes in the number of its workforce. Labor coefficient indi-

cates a number of a number of workers in each sector.

The higher the coefficient of the labor sector in the sector shows a growing number of labor required to produce the output. Instead sectors that have low labor coefficient indicates the lower the absorption capacity of its workforce. Then the multiplier effect of labor figures on Table 4 road transport subsector amounted to 0.00458 value indicates when there are changes in land transport subsector budget of Rp 0.27 trillion then a change in employment in land transport subsector amounted to 0.00458 in the Indonesian economy. In the rail transport sub-sectors when there are changes in the budget of Rp 3 trillion then a change in employment amounted to 0.08480 in the Indonesian economy. At sea transport sub-sectors when there are changes in the budget of Rp -3.52 trillion then there is a change of -0.04068 employment in the Indonesian economy. In the air transport sub-sectors when there are changes in the budget of Rp -1.8 trillion then there is a change in the employment of -0.00210 in the Indonesian economy. Sea transport sub-sectors are subsectors that have the value change of the lowest labor force, due to the budget on sea transport subsector decreased the most compared to other subsectors.

## **Conclusions and Suggestion**

### ***Conclusion***

Based on the analysis of linkage, from 6 transport subsectors are 5 sub-sectors that have a total backward linkage index is high (more than one), namely rail transport subsector; land transport; Sea transport; transport streams, lakes, and deflections; warehousing and transportation support services. This shows that the transport sector is able to attract and develop the upstream sector. In terms of total forward link, from 6 transport subsectors wholly owns total forward linkage index is low (less than one). This shows that the transport sector less able to push the output of the downstream sector. This could happen because of the construction of transport infrastructure is only focused on the island of Java and Sumatra alone, so that the transport sector less able to push the output of the downstream sector.

Three transport subsectors has a high value of output change. This shows the case of budget decreases in the transport sector, decrease the output in the Indonesian economy. The results of analysis of income and employment multiplier entire transport subsectors has a low value. The low value of the multiplier of income and employment in each subsector shows if there is a decrease in the budget of each subsector of transportation, provide a relatively low impact on the community and the household income or employment.

### ***Suggestion***

Based on the conclusions obtained, if the government cut the budget in the transport sector giving high impact of the decline in output. So expect the government in subsequent years do not take a decision to lower the budget of the transport sector, not least in the transport sector stable budget so that it will not affect output in the Indonesian economy. Future studies related to transportation in Indonesia should use the matrix data input-output tables are newer Indonesia than in 2010, thus the impact of the transport sector to reflect the state of the transport sector in Indonesia today. Further research is needed on deeper analysis, related to the impact multiplier output, income and employment generated in addition to changes to the budget. So that can know the factors that influence changes in output, incomes, and employment economy in Indonesia.

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