

Efficiency and Elasticity of Labor Use on Economic Sectors in Indonesia

Tongam Sihol Nababan

Study Program of Development Economics, Faculty of Economics
Nommensen HKBP University

Medan, Indonesia
tsnababan@gmail.com

Abstract—The research objectives are: (1) to analyze the level of efficiency and elasticity of the use of labor in Gross Domestic Product (GDP) based on economic sectors in Indonesia in the period of 2010-2016, (2) to find out the changes/ transformations in the use of labor among the economic sectors in Indonesia in the period of 2010 - 2016. The analytical method used is a descriptive and analytical method of the Cobb-Douglas production function. The results showed that during the period of 2010 - 2016 there had been a decrease in the efficiency of labor absorption in GDP at an average of 6.5% per year. The values of labor elasticity against GDP during the period 2010 - 2016 are inelastic ($e < 1$) but it is still positive. This shows a tendency to decrease changes in employment absorption of GDP. There is still an incompatibility in the business field between the ability to contribute to GDP with the ability to absorb labor. When viewed from the contribution to GDP, the transformation from the agricultural sector to the industrial sector, the service sector field and other economic sectors have been successful, but when viewed from the absorption of labor, the transformation has failed.

Keywords—efficiency; elasticity; economic sector; GDP; labor

I. INTRODUCTION

Economic growth is closely related to the rate of population growth because with a high population growth rate will also create a high workforce. In an economic development, labor has an important role due to labor becomes input (factor of production) in increasing the economic growth. Productive labor is not only viewed through a large number of workers but also through the quality of the workforce concerned. In Indonesia's economy, the use or absorption of labor can be seen in economic sectors that contribute to economic growth or contribute to Gross Domestic Product (GDP). In general, the economic sectors consist of agriculture, industry, and services. However, based on Standard Classification of Business Fields (KBLI) 2009 and New Commodity Classification (KBKI) 2010, these economic sectors have been extended and grouped into 17 economic sectors [1].

In the last ten years, there has been a shift in the structure of the economy in Indonesia, namely from agriculture to non-agriculture [2]. Although there are still a lot of workers that is absorbed in the agricultural work field, the percentage is decreasing. According to BPS, during the year of 2013 - 2015,

Indonesia's employment opportunity elasticity is inelastic with a value of 0.22 percent (employment growth as 1.02% and GDP growth as 4.56%) [2]. The value of elasticity as 0.22 percent means that one percent increase in GDP will increase as 0.22 percent of employment creation. This indicates that the percentage change in labor demand is smaller than the percentage change in GDP.

Besides, BPS also reveals in 2013-2015, there are three economic sectors which have a negative employment opportunity elasticity, consist of sectors of agriculture-forestry-fisheries, processing industries, and other services [2]. Of the three sectors, the sector of agriculture-forestry-fisheries is the sector with the biggest negative elasticity value, as - 0.57 percent. This value means that every increase in GDP in the sector of agriculture-forestry-fisheries as 1 percent will reduce a 0.57 percent of the availability of employment.

Employment opportunity contains the understanding of the amount of willingness of a production business to employ labor is needed in the production process. Employment opportunity can be created if there is a demand for labor in the labor market so that employment opportunity also shows the demand for labor [3]. An Employment Opportunity Indicator (EOI) has been developed by Feriyanto to calculate the opportunity of a working-age population including the workforce to work [4]. The EOI is calculated as follows:

$$\text{EOI} = (\text{number of working-age population}/\text{number of workforce}) \times 100\% \quad (1)$$

The growth of employment opportunity will certainly be accompanied by an increase in labor absorption. Simanjuntak states that the labor absorption is the working population absorbed and spread in various sectors [5]. Meanwhile, according to Kuncoro, labor absorption is the amount of employment that has been filled, which is reflected in a large number of the working population [6]. The effort to expand employment to absorb more labors can be done in two ways [7]: (a) industrial development, namely a type of labor-intensive industry that can absorb a relatively large number of workers in industries including home industries, (b) through various public works projects, such as the construction of waterways, dams, bridges, etc. Labor absorption basically

depends on the number of the labor demand. Labor absorption generally shows the magnitude of a company's ability to absorb a number of workers to produce products [4]. The absorption of the working population is caused by the demand for labor. Therefore, employment can be stated as the demand for labor. To measure economic growth, some economists use the data of Gross Domestic Product (GDP). GDP is the broadest measurement for the overall economic condition because it can measure income and total expenditure on the economy [8]. GDP can be interpreted as the value of goods and services produced in a country in a given year, namely the value of goods and services in a country produced by factors of production owned by the citizens of that country and foreign countries [9].

The conceptual calculation of GDP uses three types of approaches, namely: production approach, expenditure approach, and income approach. But in this study, the GDP calculation only uses a production approach. The KBLI 2009 and the KBKI 2010 has determine that GDP based on the production approach consists of 17 economic sectors, namely: (1) agriculture, forestry, and fishery; (2) mining and quarrying; (3) manufacturing; (4) electricity, gas supply; (5) water supply, sewerage, waste management, and remediation activities; (6) construction; (7) wholesale and retail trades, repair of motor vehicle and motorcycles; (8) transport and storage; (9) accommodation and food service activities; (10) information and communication; (11) financial and insurance services; (12) real estate activities; (13) business services; (14) public administration and defense, compulsory social security; (15) education; (16) human health and social work activities; and (17) other services activities [1].

According to Siahaan efficiency is a concern in the production process [10]. Efficiency is used as a parameter in measuring company performance [11]. Coelli et al. and Tribuana reveal that the concept of efficiency consists of technical efficiency, allocative efficiency, and overall efficiency [12,13]. Technical efficiency and allocative efficiency can be a productive efficiency which to a certain level can be controlled by management. The technical efficiency illustrates the capacity of an economic unit to produce maximum output with a set of inputs and certain technologies, while allocative efficiency illustrates the capacity of an economic unit to equalize the value of marginal products with marginal costs in producing these outputs.

The measurement of efficiency index can simply be explained using the basic concepts of production theory. In a company, production is defined as a process of transforming added value from input to output. The relationship between the input used and the output produced can be expressed through a standard function, namely the production function. The most widely used production function is the Cobb-Douglas production function which takes a linear-logarithmic form. The important information that can be obtained directly from this production function is the efficiency index and elasticity index. Efficiency index is expressed by a constant / intercept (α) which reflects the relationship between the quantity of output produced (Q) and the quantity of input used (X) [14]. Whereas the elasticity index is the ratio between the proportional increase of output to the proportional increase of the factors of

production [11]. Measuring efficiency does not have to use production functions. Another standard function, as the cost function and profit function, can be used as a reference in measuring efficiency. The choice between these functions is usually carried out on the basis of the assumption of exogenous. If the input quantities are used as exogenous variables, the production function is the right choice to estimate, on the contrary, if the output is used as an exogenous variable, the cost function is the right function to estimate [15,16].

The model of productivity measurement based on the Cobb-Douglas production function is one form of a production function that is most widely used in productivity analysis [14]. Basically, the Cobb-Douglas model is also a non-linear regression equation in the form of a function of appointment. The form of the model is as follows [11-16]:

$$Q = \alpha L^{\beta_1} K^{\beta_2} F^{\beta_3} e^{\mu} \quad (2)$$

Where Q = output, L = labor input, K = capital input, F = fuel input, α = intercept or efficiency parameter, β = elasticity, μ = error term. The linear form of logarithm can be written as below:

$$\ln Q = \alpha + \beta_1 \ln L + \beta_2 \ln K + \beta_3 \ln F + \mu \quad (3)$$

In the production process, efficiency can be defined as the ratio between output with a number of inputs. Mathematically, it is specified as follows:

$$\begin{aligned} \text{Efficiency} &= \text{Output} / \text{Input} \\ &= Q / [L^{\beta_1} K^{\beta_2} F^{\beta_3}] \\ &= \alpha \cdot e^{\mu} \end{aligned} \quad (4)$$

Or in the form of logarithm:

$$\text{Efficiency} = \ln \alpha + \mu \quad (5)$$

Thus, the efficiency parameter (α) can be easily obtained directly from the Cobb-Douglas production function. Some previous studies have chosen the Cobb-Douglas function with consideration of the simplicity and show satisfactory results, as has been done by [17-24].

Based on the phenomena, the understanding of the elasticity and efficiency of the labor absorption various economic sectors to be interesting to study, due to labor is an input factor in generating GDP. Therefore, this study aims to analyze the level of elasticity and efficiency of labor use on economic sectors. The next objective is to determine the level of shifts or changes in the use of labor among the economic sectors in the period 2010-2016 both in labor use and in its contribution to GDP. The results are expected to be an input to support government policy in evaluating the absorption of the workforce in Indonesia.

II. METHOD

A. Data

The data used in this study is secondary data in the form of time-series consisting of data on labor and GDP data (constant prices) based on the main economic sectors during the period of 2010 - 2016. The source of research is compiled from Central Bureau of Statistics (BPS), Survey of National Labor Force 2016, Metadata of Bank Indonesia. In accordance with the availability of data from the Central Bureau of Statistics (BPS), the economic sectors analyzed is still using the 9 main economic sectors as used in Survey of National Labor Force 2016, namely (1) Agriculture, Forestry, Hunting and Fishery, (2) Mining and Quarrying, (3) Manufacturing Industries, (4) Electricity, Gas and Water Supply, (5) Construction, (6) Wholesale Trade, Retail Trade, Restaurant and Hotels, (7) Transportation, Storage and Communication, (8) Financing, Insurance, Real Estate and Business Services, (9) Community, Social and Personal Services [1].

B. Data Analysis and Model Specifications

To describe the profile of labor used in 9 main economic sectors, this study performs the descriptive analysis. Considering the limitation of data, and the short of the study period, to analyze the value of efficiency and elasticity of labor absorption, a short-term Cobb-Douglas production function analysis is used as proposed by Gasperz. The conditions that must be met in the analysis of short-term Cobb-Douglas production functions are [14]:

- The production quantity is not negative ($Q > 0$) so that the intercept coefficient (constant) must be positive ($\alpha > 0$).
- The marginal product of the input factor must be positive, the elasticity of the output coefficient of the input must be positive ($\beta > 0$).

It is assumed that other input factors are considered fixed, and there is only one variable input, namely the number of workers. Thus the short-term Cobb-Douglas production function is specified as follows:

$$GDP_{it} = \alpha L_{it}^\beta \quad (6)$$

Where GDP is total GDP (constant price) in the economic sector i for year t , L is input (the number of labor absorption) in economic sector i for year t , α is a value of constant/intercept which shows the efficiency index. The greater the value of α means the efficiency of labor absorption is higher. β is the output elasticity of L . Whereas the elasticity coefficient of labor absorption can be calculated using the following formula [6]:

$$\text{Labor Absorption Elasticity} = \% \text{ labor growth} / \% \text{ GDP growth} \quad (7)$$

Then transformed into logarithmic form, become:

$$\ln GDP_{it} = \ln \alpha + \beta \ln L_{it} + u \quad (8)$$

III. RESULTS AND DISCUSSION

A. Gross Domestic Product (GDP) by Economic Sectors

In accordance with KBLI 2009 and KBKI 2010, since 2010, GDP data of economic sectors are grouped into 17 sectors, while the data of the number of labor released by BPS still use 9 sectors. Therefore, for the sake of analysis, the data of GDP and labor are adjusted by using 9 sectors.

As published by BPS 2016, during the period of 2010-2016 the economic sectors that give the greatest contribution to GDP are manufacturing industries (3) with an average of 22.51%; wholesale trade, retail trade, restaurant and hotels (6) by 16.97%; and agriculture, forestry, hunting and fishery (1) by 13.79%. The GDP growth during the period of 2010-2016, sector of transportation, storage, and communication (7) has the highest growth by 22%; financing, insurance, real estate and business services (8) by 12%; and construction (5) by 8%. However, compared to 2010 and 2016, there are 3 economic sectors that have a negative growth, namely: mining and quarrying (2) by - 21%; agriculture, forestry, hunting and fishery (1) by - 7%, and manufacturing industries (3) by - 2%. This shows that even though the sector of manufacturing industries (3) and agriculture, forestry, hunting and fishery (1) are the biggest contributors to GDP but during that period there have been indication of decreasing contribution, and this decline indicates an increase in other sectors, such as transportation, storage, and communication (7); financing, insurance, real estate and business services (8); and construction (5).

B. Workers Based on Economic Sectors

Based on the publication of BPS 2016 during the period of 2010-2016 the economic sectors that can absorb the largest workforce are agriculture, forestry, hunting and fishery with an average of 34.78%; wholesale trade, retail trade, restaurant and hotels by 21.49%; community, social and personal services by 15.64%; and manufacturing industries by 13.31%. The growth of employment in 2010 and 2016, the sector of financing, insurance, real estate and business services has the highest growth of 86%, then followed by electricity, gas and water supply by 39%; and construction by 30%. However, compared to 2010 and 2016, there are 2 sectors that have a negative growth in employment, namely agriculture, forestry, hunting and fishery by - 17%, and transportation, storage and communication by - 9 %. The number of labor absorption during the period of 2010-2016 shows that the absorption of labor in the sector of agriculture, forestry, hunting, and the fishery is still dominant compared to other sectors. However, the contribution to GDP is the third place after the sector of manufacturing industries; and wholesale trade, retail trade, restaurant, and hotels. This situation indicates that the sector of agriculture, forestry, hunting, and the fishery has become an "invasion" of workers who are not accepted in other sectors, thus becoming a burden for the sector.

But even though the agricultural sector cannot provide the largest contribution to GDP, this sector has become a "safety net" of employment. While other sectors, although giving a large contribution but have not been able to absorb the existing workforce. This is a problem that needs to be taken seriously

because while positive growth occurs in other sectors, it cannot reach the maximum workforce for most Indonesian population. In other words, the agricultural sector provides positive externalities for the national economy. This fact shows that there is an incompatibility between the ability to contribute to GDP and the ability to absorb the labor. The transformation of the economic sector (viewed from the contribution to GDP), from the sector of agriculture to the sector of industry, and to the sector of service business and other sector has been successful, but seen from the absorption of labor for these sectors has failed. Seeing this fact, the government needs to be more active in increasing agricultural activities. Efforts that can be made are optimization of land use including the legality of land ownership, the opening of new agricultural areas through the construction of connectivity facilities such as road construction, irrigation construction, improving distribution channels, and others.

C. Relationship between GDP Growth Rate and Labor Absorption

There is an interesting phenomenon of the relationship between the GDP growth rate and the growth rate of employment in Indonesia's economic sectors during the period of 2010 - 2016. Theoretically, the relationship between the rate of economic growth (GDP) and employment is when economic growth can open new employment so that labor absorption will occur [6-21]. The phenomenon that occurs includes 4 patterns of indications of economic sectors in Indonesia, namely: Anomaly, Progressive, Regressive, and Proportional [6]. The anomaly occurs if growth index of $GDP > 0$ and growth index of labor absorption < 0 , Progressive if growth index of $GDP <$ growth index of labor absorption, Regressive if growth index of $GDP >$ growth index of labor absorption, and Proportional if growth index of $GDP =$ growth index of labor absorption. Table 1 shows the relationship between GDP growth rate and growth of labor absorption rate.

TABLE I. CATEGORY OF RELATIONSHIP BETWEEN GDP GROWTH RATE AND GROWTH OF LABOR ABSORPTION RATE IN ECONOMIC SECTORS IN PERIOD OF 2010 – 2016

Category	Economic Sectors
Anomaly	(1) Agriculture, Forestry, Hunting and Fishery ($0.040 > -0.015$)
Progressive	(2) Mining and Quarrying ($0.013 < 0.033$) (4) Electricity, Gas and Water Supply ($0.055 < 0.077$) (8) Financing, Insurance, Real Estate and Business Services ($0.075 < 0.135$)
Regressive	(3) Manufacturing Industries ($0.049 > 0.020$) (6) Wholesale Trade, Retail Trade, Restaurant and Hotels ($0.055 > 0.029$) (7) Transportation, Storage and Communication ($0.094 > 0.002$) (9) Community, Social and Personal Services ($0.058 > 0.035$)
Proportional	(5) Construction ($0.067 > 0.064$)

The anomaly that occurs in the sector of agriculture, forestry, hunting, and fishery shows that this sector has failed to carry out its function as a driver of employment increase. Even the positive economic growth (GDP) in this sector has a negative impact on employment. It is suspected that the cause of this incident is a shift in the nature of labor-intensive into capital intensive in the sector. The most expected pattern is a progressive where economic growth has a high impact on the rate of employment growth.

D. Estimation of Efficiency and Elasticity of Production (Output) of Labor on GDP

To compare the level of efficiency of labor absorption and output elasticity on GDP each year, it can be done with short-term Cobb Douglas production functions. This function can be analyzed in the form of transformation or original form. Estimation of short-term Cobb-Douglas production function in both transformation and original forms for each year are presented in table 2.

TABLE II. SHORT-TERM COBB-DOUGLAS PRODUCTION FUNCTION OF GDP

Year (<i>t</i>)	Original Form ($GDP_t = \alpha L^{\beta}$)	Efficiency Level
2010	$GDP = 912.32L^{0.419}$	-
2011	$GDP = 606.68L^{0.448}$	Decrease by 34%
2012	$GDP = 637.78L^{0.447}$	Increase by 5%
2013	$GDP = 775.88L^{0.438}$	Increase by 22%
2014	$GDP = 715.51L^{0.445}$	Decrease by 8%
2015	$GDP = 695.06L^{0.446}$	Decrease by 3%
2016	$GDP = 549.49L^{0.465}$	Decrease by 21%

For production analysis, the Cobb Douglass production function used is the original form. As shown in Table 2, both assumptions proposed by [14] namely $\alpha > 0$ and $\beta > 0$ have been fulfilled. By observing the efficiency ratio during the period of 2010 - 2016, it can be stated that there has been a decrease in the efficiency of the use of labor on GDP with an average of 6.5% per year. The values of labor elasticity on GDP during the period of 2010 - 2016 are inelastic ($e < 1$) and positive. Inelastic values indicate a tendency to decrease in changes of labor absorption on GDP, while positive values mean that in the short term the increase in the number of labors will increase the GDP.

Furthermore, to find out how much the impact of changes in GDP on changes in labor, it is necessary to calculate the elasticity of labor absorption. The elasticity of labor absorption for each sector are presented in Table 3. It shows that the sector of 1, 5 and 7 have an inelastic value and inversely related. This means that the increase of GDP growth actually decreases the employment. There is a shift from intensive labor to capital intensive in these two sectors. Table 3 shows that the elasticity of labor absorption of economic sectors of 2, 4, and 8 have the elastic and positive value. It means that GDP growth in these three sectors can increase labor absorption. While other sectors of 3, 6 and 9 have an inelastic value but still be positive. The GDP growth in these four sectors can increase the labor absorption, but it bellows the percentage of GDP growth.

TABLE III. ELASTICITY OF LABOR ABSORPTION IN PERIOD OF 2010 - 2016

Economic Sectors	2010	2013	2016	Average
1	-1.469	-0.222	0.018	-0.558
2	3.351	4.353	1.113	2.939
3	0.829	-0.961	0.436	0.101
4	0.021	0.076	4.510	1.536
5	1.331	-1.199	-0.536	-0.135
6	-0.094	0.485	0.305	0.232
7	-1.187	0.101	0.354	-0.244
8	6.298	0.963	0.389	2.550
9	0.013	1.204	0.506	0.574

E. Impact of Efficiency and Elasticity in Labor Mobility

Hugo describes that, in the city, the growth rate of the manufacturing industry and other employment opportunity tends to attract people out of the agricultural sector [22]. The employment in the agriculture sector is a space for expansion of the socio-economic fields that many rural labor forces occupy. Considering that most industries are located in urban areas, there is simultaneously a shift from rural to urban areas. Besides, now, in the era of globalization and modernization, one of the developing realities of employment in Indonesia is the decline in the interest of the young labor to work in the agricultural sector. This sector is considered to be less able to provide adequate income to live properly [23]. Even though the wage level of agricultural laborers has increased, but it is still far below the increase in the level of non-agricultural sector wage.

The Survey of National Labor Force 2016, Bank Indonesia has carried out the more interesting analysis by observing the flow of movement of economic sectors [1]. This analysis is useful to investigate the shift in economic sectors that are able to absorb the labor. Thus, it will be able to know which employees are labor-friendly and who are able to hold the labor. At the macro level, this information can be used to determine the structure of labor absorption in each economic sectors. In addition, it can also be used as a basis for determining the direction of the population and employment-based sectoral development, precisely the development centered on the population and labor. This analysis can also detect how many workers are doing mobility/transfer of work from one job to another, or who are doing mobility/moving work but it is still on the same work.

IV. CONCLUSION

The values of labor elasticity on the GDP during the period of 2010 - 2016 are inelastic ($e < 1$) but still positive. This shows a tendency to decrease changes in labor absorption of GDP. Of all economic sector, the only sector of mining and quarrying business has an elastic value ($e = 1, 852$), meaning that the economic growth (GDP) of this sector by 1% can absorb an increase in labor by 1.852%. Then, the growth pattern of GDP and labor in the agricultural sector show an anomalous pattern. The sectors of mining and quarrying; electricity, gas and water supply; financing, insurance, real estate, and business services have the progressive pattern. The sectors of manufacturing

industries; wholesale trade, retail trade, restaurant, and hotels; transportation, storage, and communication; community, social and personal have a regressive pattern, whereas the sector of construction has a proportional pattern.

There is an incompatibility between the ability to contribute to GDP with the ability to absorb the labor. The transformation of the economic sector when viewed from the contribution to GDP, from the sector of agriculture to the sector of industries, the sector of service, and to other sector has been successful but viewed from the absorption of labor for those sectors, it has failed. The mobility activities are based on economic motivation to get a better income level, many workers choose to leave the agricultural sector and conduct non-permanent mobility to other districts or cities by working in other business fields such as industry, trade, or services that can provide higher wages than they have to work as agricultural sector workers.

The emergence of the trend of work mobility among sectors is also influenced by wage expansion coupled with a sustained increase in labor productivity. Linking wages with increased productivity can help drive the equitable growth. Therefore, the government is expected to optimize investment in labor market institutions. Furthermore, it is also hoped that the government will continue to strive to encourage informal workers to become formal workers by entering the formal economic sector to be more protected.

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