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The Technical Efficiency of the Coffee Processing Industry in the Province of West Java

Wilda Widya Sari[1], Imam Asngari[2], Deassy Apriani[3*]
Development Economics Study Program, Faculty of Economics, Sriwijaya University
Corresponding Author: Deassy Apriani
deassyapriani@fe.unsri.ac.id

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A B S T R A C T

The development of coffee in West Java has experienced a very rapid increase in production. Coffee is a commodity that has economic value and is a superior commodity that helps the economy and GDP in West Java. Therefore, this research has the purpose of determine the effect factors of production on the output and measuring technical efficiency in the coffee processing industry in West Java. The type of data used is secondary data related to the coffee processing industry for the period 2011 to 2020. The research method used is the Stochastic Frontier Analysis approach using the Cobb-Douglas production function. The results of the study indicate that the coffee processing industry in West Java during the period from 2011 to 2020 is not technically efficient with a coefficient of 0.76. The variable of capital has a significant negative effect on the output produced by producers in the coffee processing industry, while the variable of labor and raw materials has a significant positive impact on the output produced by producers in the coffee processing industry in West Java.

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INTRODUCTION

The plantation sector plays an important role in the peace and welfare of the people through foreign exchange earnings, providing job opportunities, encouraging the development of agribusiness and agro-industry. The plantation sub-sector is one of the agricultural sub-sectors that contribute to the Indonesian economy by 163.49 trillion or 28.59 percent in the third quarter of 2020. According to the Central Statistics Agency (BPS) in 2020, plantation export data in the January to October 2020 period reached 359.5 trillion or 11.6 percent. The various commodities produced by the plantation sub-sector increase opportunities to stimulate Indonesia's economic growth both at home and abroad.

According to research by Apriani & Rostartina, (2017) and Khaeroni, (2018) coffee is one of the plantation products that has economic value and is consumed for refreshing drinks but can also be used for pharmaceuticals and cosmetics. The coffee commodity in Indonesia has an export volume of 639.01 thousand tons with an export value of US$872.4 million in 2019 (BPS, 2019)Coffee production provides opportunities for the country's economy, especially coffee center areas on smallholder plantations (Direktorat Kajian, 2017). So that it attracts coffee producers to increase their business in order to achieve market share with supporting raw materials.

Therefore, a strategy is needed to increase the added value of the coffee processing and production capacity (Apriani & Rostartina, 2017) West Java is one of the producing provinces Coffee production in Indonesia, which is capable of producing coffee, reached 21 thousand tons in 2019 so that plantation products are exported abroad (Fajarta, 2021)In 2020 coffee production increased so that exports reached 160 tons of various types of coffee. West Java has an average land area and Arabica coffee production namely 21 thousand hectares and 10 thousand tons. Whereas average land area and amount arabica coffee production namely 16 thousand hectares and 8 thousand tons. Arabica coffee is superior to robusta coffee because arabica coffee grows in areas that have loose soil, evenly distributed rainfall and sufficient sunlight and on higher ground. Meanwhile, Robusta coffee should be grown in lower lands with higher temperatures (Rizani, 2022).

In the coffee production process, producers will use production factors as much as possible at a predetermined cost (Febrianti et al., 2020) If the production factors used are not optimal, the processed coffee will also produce output that is not optimal and will certainly affect the income that will be received by the company or producer of the coffee processing industry in West Java.. This is in line with research conducted by Junaidi & Hidayat, (2017) and (Tungga Dangin & Marhaeni, 2019) Production factors are also absolute in the production process. This is because production cannot take place without the factors of production. The production function represents the technology used in a company, industry, or the economy as a whole. Coffee producers benefit by producing large amounts of processed coffee in terms of added value so that they only focus on profits in terms of quantity which will show the performance of the production process. This is related to the performance indicator, namely

the level of efficiency, because it describes a number of outputs through a combination of fewer inputs, so as to minimize production costs without having to reduce the output produced. Production activities will provide benefits to achieve the maximum level of efficiency (Kustiari, 2007).

Efficiency is one of the determinants which is on the industry's performance on the productivity component which refers to the actual ratio and the optimal number of inputs and outputs. Then productivity will link input and output by forming a ratio (Ngatindriatun dan Hertiana Ikasari, 2011). Efficiency will be measured through efficiency technical with approach Stochastic Frontier Analysis. Technical efficiency is the ability to minimize the use of inputs in producing certain outputs or obtaining maximum output from certain inputs (Essmui et al., 2013). Where the TE score is between 0 to 1. If the value of 1 indicates technical efficiency and is at the production limit. However, if it is less than 1 then the technical efficiency is not yet below the production limit. The measure of technical efficiency is oriented to the extent to which it produces a certain output (Coelli et al., 2003)

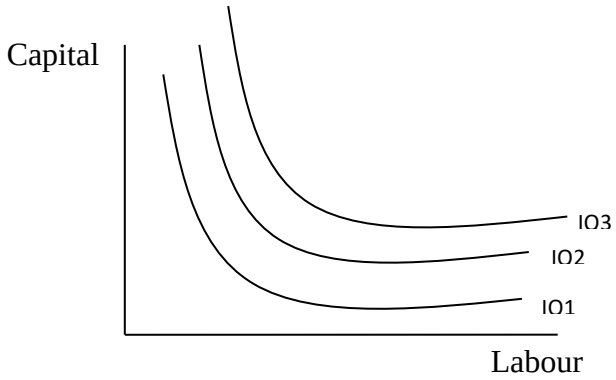
How to measure score efficiency technical with use approach Function - focused Stochastic Frontier Analysis production Cobb-Douglas Production function Cobb-Douglas is a production function that researchers use in empirical studies when conducting research. The use of production results consists of the functions of capital (K) and labor (L). So it can be stated that the results obtained from the production function are in the form of quantity and provide certain income as well. Then function production will related with function limit production for describes how the output of the process is generated to the maximum. The Stochastic Frontier Production Function Model can be understood as a contribution to econometrics, which is an estimate of a company's technical efficiency.

THEORETICAL REVIEW

Production

Production is the activity of creating goods or services to meet everyday human needs. This process is carried out to create and provide use value from goods or services followed by the use of production factors so that production results have the ability to meet the needs of the user (Basuki & Prawoto, 2014).

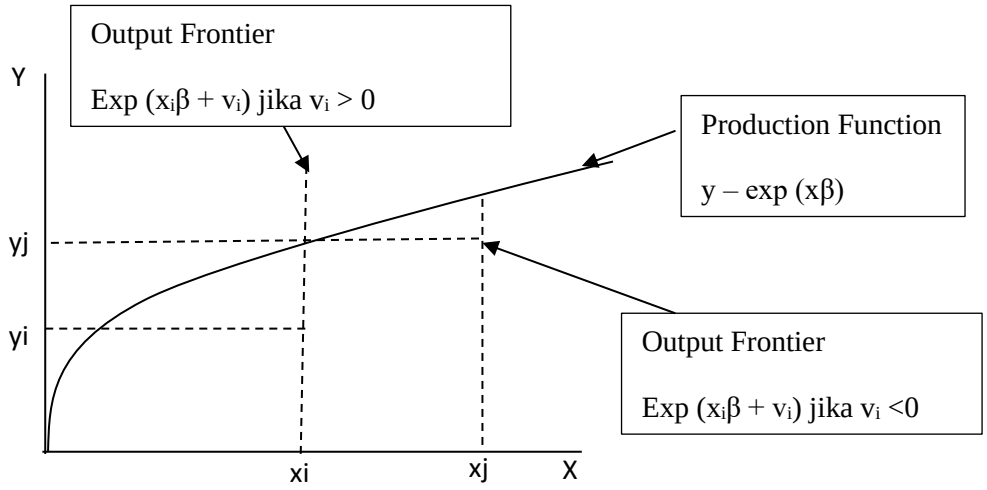
The production function is the relationship between inputs and outputs for the production of goods and services in a particular industry. Then, the production function can be explained using two inputs, namely capital and labor, which can be written as Q = f (K, L). The curve that describes the two-input production function is an isoquant. The characteristics of this isoquant curve are that if it is far from zero, it will produce a larger total input and a larger total output. Conversely, if the isoquant is close to zero, it will reduce the input quantity and output quantity (Basuki & Prawoto, 2014).



Source: Sukirno, 2012
Figure 1 Isoquant Curve

Stochastic Frontier Analysis Production Function

Stochastic Frontier Analysis analysis was first put forward by Aigner, Lovell, and Schmidt in 1977 and Meeusen and Van Den Broeck in 1977 on Battese and Collie in 1992. The analysis used by Stochastic Frontier Analysis is using the maximum production that causes a given result must sacrifice a number of production inputs (Asikin et al., 2019).



Source: Subal C. Kumbhakar, 2000
Figure 2 Frontier Production Function

In the frontier approach, the company can be influenced by factors that are beyond the control of the production unit. The Stochastic Frontier model assumes that output is limited by a stochastic production function. In the Cobb-Douglas production function, the model is constructed as follows (Coelli et al., 2005):

$In\ q_i = \beta_0 + \beta_1 \ln X_i + v_i - u_i$ .....(1)

$q_i = \exp(\beta_0 + \beta_1 \ln X_i + v_i - u_i)$ .....(2)

$q_i = exp(\beta_0 + \beta_1 \ln X_i) \times \exp(v_i) \times \exp(-u_i)$ .....(3)

Information: q_i : Output from the company i ; X_i : Input; $exp(\beta_0 + \beta_1 \ln X_i)$: The determinant component; exp (v_i) : Noise; exp (-u_i) : Ineficiency.

There are two deviations in the variables vi and ui which are divided into symmetric elements which provide random variations of the frontier in the observations and include the effect of a measurement error. Then the one-sided component comes from the deviation which includes the effect of inefficiency.

Technical Efficiency

Technical efficiency is the ability to minimize the use of inputs in producing certain outputs or obtaining maximum output from certain inputs. Where the TE score is between 0 to 1. If the value 1 indicates technical efficiency and is at the production limit. However, if it is less than 1 then it is not yet technically efficient and under production limits. The measure of technical efficiency is input-oriented, which is the extent to which it produces a certain output (T. Coelli et al., 2003). Mathematically, engineering efficiency can be written mathematically, namely (T. Coelli, 1996):

$$Ef\ f_i = \frac{E\ (Y_i|U_i,X_i)}{E\ (Y_i|U_i=0,X_i)} \quad \text{.....(4)}$$

Information: Eff = Technical Efficiency; I = Company; E = Estimation; Y= Production Value; X = variables ; U = error

Hypothesis

1. It is estimated that the production of the coffee processing industry in West Java has not reached the level of efficiency, technically.
2. Estimates for production inputs (capital, labor and raw materials) have a positive and significant impact on the output value of the West Java coffee processing industry.

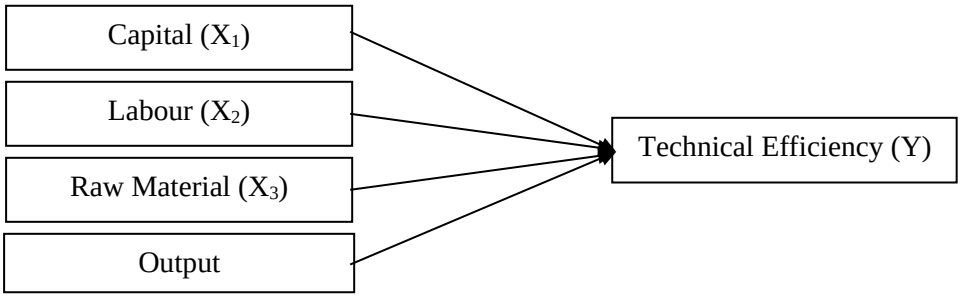


Figure 1. Conceptual Framework

METHODOLOGY

This study focuses on the determinants determinants of performance, namely technical efficiency using production factors, namely capital, labor and raw materials using the Stochastic Frontier Analysis approach from 2011 to 2020. The type of data used in this study is secondary data obtained from the Indonesian of Statistics. West Java Province in the coffee processing industry (ISIC: 10761). This study will measure technical efficiency and the effect of production factors on the output value of the coffee processing industry in West Java from 2011 to 2020.

The analytical technique used in the research this that is use function production Cobb-Douglas with approach Stochastic Frontier Analysis (Khai &

Yabe, 2011). Function this mommy measure efficiency technical with tool measuring that is Frontier 4.1c software . In accordance with Coelli 's theory (1996) function production Cobb-Douglas for To do transformed regression in the linear form of the natural logarithm as following:

LnEf= β_0+β_1 LnK+β_2 LnL+β_3 LnBb+(v_i-u_i) …….(5)

Information: Ef = Technical efficiency; B0 = Output Value (Q); X1= Capital (K); X2 = Labor (L); X3 = Raw Material (Bb); Vi = Error of external factors; Ui = Effect of technical inefficiency in Model.

The value of technical efficiency will be calculated through frontier software version 4.1c. The result of the technical efficiency value is the same as the one that is declared efficient. However, the processed data results are less or not equal to one, then the input used is inefficient.

RESULTS

Estimation result Frontier 4.1C , known that modal variable has influence significant to variable output value. This means that the capital variable has an effect on the output value. The coefficient value of the capital variable has a negative sign to the output value of -0.550. This value means that when capital increases by one percent, output will decrease by -0.550. This coefficient value directly shows the elasticity value of the coffee processing industry in West Java. This condition occurs because the coffee processing industry is one of the labor-intensive industries, namely an industry that uses more human resources than the use of technology, so that the standard of managerial ability and human resource skills can be achieved (Olivia, 2020). In line with previous research, namely Pratiwi, (2014) and Pataniho & Fevriera, (2022) that the value of the elasticity of capital is negative which indicates that capital has not been able to increase production.

Table 1. Frontier Production Function Estimation Results

Variable	Coefficient	Standard-Error	t-ratio
Constant (β_0)	0.175476	0.10214	0.171807
Capital (β_1)	-0.55097	0.63347	-0.86976
Labor (β_2)	0.213374	0.5191	0.411047
Raw Material (β_3)	0.587933	0.59412	0.989589
Sigma-squared	0.294202		
Gamma	0.999999		
LR-Test	0.676592		
ɳ Technical Efficiency	0.762125		

Source : Output Frontier 4.1C, (2022)

Then the labor variable has a significant positive relationship to the output variable. This means that the labor variable affects the output value. The resulting coefficient value is 0.213. This value means that when the workforce increases by one percent, the output will increase by 0.213 (Belete, 2020). This coefficient value directly shows the value of the elasticity of the coffee processing industry in West Java. So these results are in accordance with the

Cobb-Douglas s hypothesis and theory which states that the value of input (labor) increases when output increases. In line with research by Aji, (2020) and Sartin, (2018) , namely if the use of labor input increases by one percent, it will increase production output.

In the raw material variable the coefficient value is 0.587 which means raw materials are inelastic. When the addition occurs ingredient raw by 1 percent , then cause the value of output increased by 0.587 percent . In accordance with research conducted by Andriani, (2017) with the results of research on raw material variables having a positive and significant influence on production results or output. This result is consistent with one of the properties of the Cobb-Douglas production function, namely increasing return to scale . In this case, the output increases more than the addition of the input.

In addition, the T test value explains that the capital production factor has a significant negative effect, which is -8.697 > t-table. Then for labor worth 4.110 > t-table which has a positive and significant effect on the output value. And the raw material variable also has a positive and significant value to the output of 9,895 > t-table. In the gamma test, the gamma value is 0.99999 0, so the result is that the output value of the coffee processing industry in West Java is not yet fully efficient. When the Sigma-Squared Test gives a t-count value of 0.123 which is smaller than the t-table value caused by the maximization of the use of production factors. Finally, in the LR-Test test the resulting value is 0.676. This value is lower than the table Chi Squared x2 which means that the model used in this study is in the form of Cobb-Douglas.0.99999 0, so the result is that the output value of the coffee processing industry in West Java is not yet fully efficient. When the Sigma-Squared Test gives a t-count value of 0.123 which is smaller than the t-table value caused by the maximization of the use of production factors. Finally, in the LR-Test test the resulting value is 0.676. This value is lower than the table Chi Squared x 2 which means that the model used in this study is in the form of Cobb-Douglas.

Table 2 the results of Frontier 4.1C, the efficiency output results are obtained for 10 years from 2011 to 2020. The average efficiency level of the coffee processing industry in West Java is 0.76 with three years the efficiency level is below the average and for the other seven years have an efficiency level that is above average. So this explains that the producers of the coffee processing industry in West Java have not been able to increase the quantity of production and must make additional inputs. The highest efficiency level from 2011 to 2020 occurred in 2012 and 2017 which was 0.99 and the lowest occurred in 2016 at 0.35.

Table 2 Estimation Results of the Efficiency Level

Year	Efficiency Level
2011	0.31
2012	0.99
2013	0.91

2014	0.59
2015	0.9 4
2016	0.35
2017	0.99
2018	0.85
2019	0.83
2020	0.81
Average	**0.76**

Source: Frontier Output 4.1 (2022)

In 2012 all factors of production increased with the value of output also increasing from the previous year by 45.2 percent, followed by the number of producers, wages, capital, labor, and raw materials.. In 2017 it also almost reached the level of technical efficiency of 0.99 with an output value of 7.82 billion rupiah. This was also triggered by an increase in raw materials from the previous year, an increase in the number of producers and the West Java Festival in 2017 to introduce various kinds of West Java coffee organized by the Industry and Trade Office in collaboration with the West Java Province Plantation Department (Kusumaningrum, 2017)However, based on the theory of Coelli, et al and the theory of Khumbakar, it is stated that the value of technical efficiency is equal to one with input orientation.

Meanwhile, 2016 has the lowest efficiency level for the 10 years. The value of the low efficiency level in 2016 was due to the decreased output value of -65.8 percent, followed by a decrease in the value of raw materials, wages and the number of producers of the coffee processing industry in West Java.

If it is seen from 2011 to 2020 that the level of technical efficiency of the coffee processing industry has increased. This is due to the increasing ability of coffee processing industry producers in West Java to maximize production output. while the number of producers in 2011 to 2020 fluctuated and tended to decline due to coffee producers who failed to achieve efficiency when carrying out the coffee processing production process. So it can be interpreted that during 2011 to 2020 the coffee processing industry in West Java has not yet reached the production limit, because coffee producers do not maximize production factors with the resulting output.

DISCUSSION

Output value is the output value obtained from the process of industrial activities in forming a good or service into something that has a use value by selling electricity, other income, income from industrial services and the value of the stock of semi-finished production goods. (Pamungkas, 2020).

Output value of the coffee processing industry is fluctuating and tends to increase from year to year. This happens because of changes in raw materials, the amount of labor, capital in producing output (Popović & Panić, 2018). The average output value of the coffee processing industry in West Java is 5.1 billion

with an average growth of 31.8 percent. The highest value occurred in 2017, a bigger increase than in previous years. The output value in 2017 reached 7.8 billion from the previous year. These changes occurred due to the increase in raw materials and energy use from the previous year, thus affecting the output value. The results of this study are in line with the research of Andriani, (2017) and Pataniho & Fevriera, (2022) whose research results are that when the output value increases, the value of raw materials will also increase.

Negative growth in output value occurred in 2013, 2015, 2016 and 2018. 2016 was the lowest year from 2011 to 2020 by providing an output value of 1.8 billion with growth reaching negative 65.8 percent. The decline occurred due to a decrease in the use of production factors such as the value of raw materials by 60.6 percent and a decrease in the services of the coffee processing industry in West Java. The slowdown in production activities was also due to a significant decline in the number of companies by 32.7 percent .

Fixed capital consists of land, buildings, machinery, vehicles, and other capital (Muin, 2017). The average capital of the coffee processing industry in West Java from 2011 to 2020 is 1.3 billion. The highest capital occurred in 2014 at 4.1 billion rupiah and the lowest in 2017 at 458 million rupiah. The increase in capital in 2014 was due to the large purchases of various types of capital such as land, machinery and vehicles. A total of 77.4 percent of total capital in 2014 was in the form of machinery and land. In 2017 capital decreased by 52.6 percent due to a decrease in the value of machinery, buildings, land, vehicles and other equipment. The increase and decrease in the capital of the coffee processing industry which is not fixed from year to year gives an average of 41.2 percent. The increase occurred starting from 2012 amounting to 793 million rupiah to 1.4 billion rupiah in 2013 with an increase of 84.6 percent. Furthermore, the highest capital after experiencing a decline in 2017 was in 2018. The capital obtained by the coffee processing industry in 2018 was 1.2 billion rupiah. This resulted in a significant increase in purchases of land, vehicles, buildings and other equipment. In addition, there is an interest from entrepreneurs to open a business in the coffee processing industry in West Java (Hanafi, 2017).

The workforce in the coffee processing industry is divided into production workers and other workers. Production workforce is 77.40 percent and other workers are 22.60 percent. Male workers are superior to female workers, which is 52.58 percent of the total workforce used every year. The highest number of workers occurred in 2013 as many as 43,521 people and the least occurred in 2013 and 2020 as many as 20,552 people. In addition, Table 3 shows that from 2016 to 2020 the female workforce began to increase compared to men. According to the Coordinating Ministry (2019) and Qothrunnada, (2022) women can be strategic actors in development. Not only development in villages, but national development that can change people's lives to become more prosperous. In addition, the work carried out does not have to be a civil servant, a private employee, but can be done by building employment opportunities such as establishing a home industry that absorbs labor. Then access to technology also makes it easier for women to generate income without having to be away from their families, such as setting up micro businesses. So

women are more likely to open their own businesses and create jobs to not depend on others.

The number of workers in the coffee processing industry is not in line with the number of existing producers (Putri, 2022). The highest number of workers occurred in 2013, while the highest number of producers was in 2015. However, the lowest was in 2020 due to the impact of the pandemic on companies, besides that the trigger was also the economic crisis and an increase in the value of production inputs. production value adjustment.

Then the highest worker wages in 2012 amounted to 841 million rupiah and the lowest occurred in 2020, which was 233 million rupiah. The large number of workers used causes producers of the coffee processing industry to incur large costs for the labor used (Basuki & Prawoto, 2014). Expenditures for production workers tend to be higher at 69.94 percent compared to other workers' expenditures at 30.06 percent. This is because the use of labor directly related to the production process is more than other workers who are not directly related to the production process. So the production workforce in the coffee processing industry in West Java makes human resources the most important factor in the production process (Sieng et al., 2021).

The value of raw materials during 2011 to 2020 fluctuated. The highest increase occurred in 2017 by 127 percent from the previous year, which is like the output value of the West Java coffee processing industry in the same year. So it proves that a large amount of raw materials will produce a large output value as well and there is a relationship between the two. Then, in 2018 the value of raw materials decreased by 1.92 percent. This happens because of insufficient raw materials, but production can still run. The lowest raw materials occurred in 2016 with a decrease of 60.65 percent, the same as the lowest decline in output value in 2016. So if the value of raw materials decreases, the value of the output produced will also decrease (Andriani, 2017).

CONCLUSIONS AND RECOMMENDATIONS

The coffee processing industry in West Java has not yet reached the production limit, the average level of efficiency from 2011 to 2020 is only $0.76 < 1$, which means because that the coffee processing industry is not efficient. This condition occurs because the production factors used by coffee processing industry producers in West Java have not been maximized, so the output produced is not optimal.

Factors of production consisting of capital, labor and raw materials have different results. The capital variable (K) has a negative and significant value on the output value, while for labor (L) and raw materials (Bb) it has a positive and significant impact on the output value of the coffee processing industry in West Java.

FURTHER STUDY

The variable of capital has a significant negative effect on the output produced by producers in the coffee processing industry, while the variable of labor and raw materials has a significant positive impact on the output produced by producers in the coffee processing industry in West Java.

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