Jurnal Ekonomi Pembangunan
Volume 18 (1): 13-20, June 2020
P-ISSN: 1829-5843; E-ISSN: 2685-0788

Examining the technical efficiency of small industries: A case study of the crackers industry in South Sumatera, Indonesia

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Article Info: Received: 2020-01-27; Accepted: 2020-06-06; Published: 2020-07-12

Abstract: Small industries are life-sustaining for communities because of their political and strategic position in terms of creating job opportunities and increasing revenue. One small industrial sector that has the potential to be developed is the food industry. Small food industries are widely scattered in every area, including in the city of Palembang. A small industrial group of food that became one of the culinary icons in Palembang is the cracker industry. This type of industry is a culinary icon that has been famous for foreign countries. Nevertheless, the cracker industry is still experiencing obstacles in terms of capital and marketing. The cost of raw materials is relatively expensive to technically trigger the industry inefficiencies. Therefore, it is necessary to review the technical efficiency of this small industry. The variables used in this study were capital, labor, and output. The data used is secondary data that is analyzed by using the Stochastic Frontier Analysis (SFA) approach. The results showed that the technical efficiency achievement of small industrial crackers in South Sumatera is still categorized as low. The use of labor input is more effective than capital use as a result of the utilization of technology and local resources. Therefore, the development of small industrial crackers through an efficiency approach cannot be separated from the application of technology, human resource management, marketing, and business climate.

Keywords: technical efficiency, stochastic frontier, small industry

JEL Classification: L25, L66

How to Cite:
Mukhlis, M. (2020). Examining the technical efficiency of small industries: a case study of the crackers industry in South Sumatera, Indonesia. *Jurnal Ekonomi Pembangunan, 18*(1): 13-20. DOI: https://doi.org/10.29259/jep.v18i1.10847

1. INTRODUCTION

The development of small industries in Indonesia aims to strengthen the national economy, increase public income through job opportunities and end up in increasing economic growth. It became important considering the social and political potential of small industry strategically due to its great ability to absorb manpower by utilizing domestic resources (Kuncoro, 2003). Atherton (2005) describes the important role of small industry in encouraging all business activities in all phases of the economy. Small industries play an important role in supporting the increasing economic productivity of a country. Research by Aquilina, Klump, & Pietrobelli (2006), discovered in the last four decades, small industries around the world have grown, both in absolute and relative.

The underlying reason for the development of small industries is the intensity of local natural resources use in its production activities. Small industrial locations are generally located in rural and suburban areas. Through the utilization of local resources, the existence of these small industries can have a positive impact on the absorption of manpower, reducing the number of unemployment and population of poverty, and the inequality of income distribution (Mukhlis, Robiani, Marwa, &

Chodijah, 2017).

The government has provided capital assistance and issue deregulation policies to adjust the structure of the economy. However, it lacks benefits for small industries, even tends to ramp up on the spot. Government partnership efforts with small businesses also give less satisfactory results. (Kuncoro, 2013), in his study found only 11 percent of small businesses benefiting from the partnership.

During 2008-2018, small industries in South Sumatra experienced significant growth of 4.59 percent. This shows that the small industry plays an important role in supporting the economic growth of South Sumatera. Based on the results of the survey of the industry group in 2016, small industries contributed considerable contribution to the total contributions of the entire industry group. Recorded contribution amounted to 98.46 percent and the remaining 1.54 percent came from the contribution of medium and large industries (Central Bureau Statistics of South Sumatra, 2017).

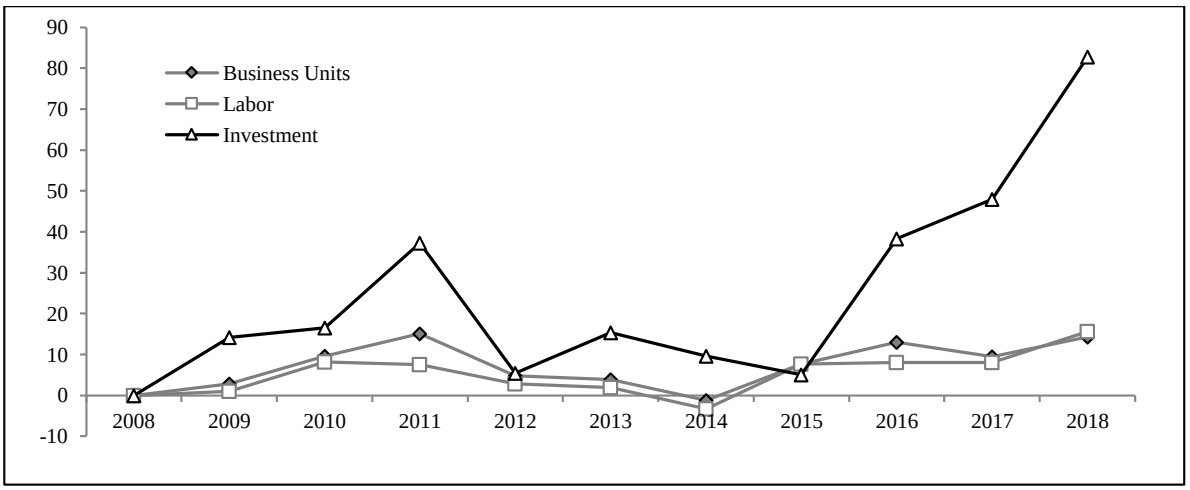

Figure 1. The trend of small industry developments in South Sumatera, 2008-2018
Source: Central Bureau Statistics of South Sumatra, 2019

The increase in the small industry in South Sumatera, both from the number of business units, manpower, and investment value during the 2008-2018 period, greatly fluctuated and showed an improved trend. This shows a good response to small business development efforts in South Sumatera, especially in promoting employment, business opportunities and income in South Sumatera.

Small industrial sub-sectors that play a dominant role in the economy in South Sumatera are derived from the food sub-sector. One is the cracker industry with a contribution of 27.5 percent of the total food industry as many as 4,025 business units. Nowadays the crackers industry is growing in line with the increasing number of demands. Nevertheless, the cracker industry is still faced with some obstacles, such as lack of raw materials, technology, and market access.

Although capital assistance and business incentives have been given by the Government but have not made a significant impact on the development of the crackers industry. Most small industrial producers have not been able to meet market demands for good quality products, fast and timely delivery, as well as large quantities of orders. Besides the production technology used is still traditional, which has an impact on low competitiveness.

Related to the consumer needs of quality products and expensive raw materials, the manufacturer of crackers should think creatively by sticking to the principle of efficiency and productivity. According to this condition should be a serious concern for every small industry in each area. In-efficiency as a result of the un-optimal production scale should be increasingly pressed so that the small industrial products can withstand the competition with large industries (Yuliana, Robiani, & Mukhlis, 2018).

Many factors affect the efficiency of the cracker industry and are usually intertwined with each

other. In line with the opinions of Pettigrew (1992) stating that the performance of small industries measured by technical efficiency is influenced by various factors that scope, complex and often associated with other problems that are difficult to separate. Measurement of small industrial efficiency of crackers is very different from the methods used against the medium and large industries. In line with Murphy, Trailer, & Hill (1996), efficiency measurement accuracy is an important issue for understanding the success and failure of small businesses.

The improvement of technical efficiency in the crackers industry is expected to improve the competitiveness and sustainability of the crackers industry. Therefore, it needs to be conducted in-depth studies that can be used as a cornerstone of the development of the crackers industry, especially those relating to aspects of increasing efficiency. There are several techniques for measuring technical efficiency, including using a production model of Stochastic Frontier that aims to see the relationship between inputs and outputs used in the production process of small industrial crackers in South Sumatra.

2. LITERATURE REVIEW

2.1. Small Industry

Small industries are often defined as industries that have a total workforce of between 5 and 20 people, consisting of paid workers and workers originating from families who are not getting paid. Generally, the industry with the amount of manpower is also classified as a domestic industry or handicraft. In economic theory, small industries are defined as a group of companies that produce similar goods. While the company itself is defined as a unit that uses production factors to produce commodities that are sold to other integrations, households or governments

The economic theory assumes some of the properties of the company as follows: 1) Every company makes a consistent decision as if the company is an individual. So economic theories ignore the internal problems of people making decisions, and how those decisions are accomplished; 2) Most companies make decisions to maximize profits; and 3) The company is the main user of the production Factor services (Jehle & Reny, 2001).

2.2. Production Concept

Production is all activity to increase the value of the object and can be an activity generating new items or activities that enhance the usability of an object. Production can also be interpreted as a result of economic activity using the available inputs. According to Jehle and Reny (2001), production is an activity that is measured as an output per unit or period time. The output produced depends on the number of inputs used in the production process, where the relationship between the inputs and outputs is described in the production function.

2.3. Efficiency

Efficiency is a concept that refers to the relationship between inputs and outputs. There are many types of efficiency with different measuring methods. Among them are technical efficiencies that can be used to compare the efficiency levels of each economy unit in the same or similar levels. Technical efficiency also explicitly considers the use of the number of inputs to produce output (Jondrow, Knox Lovell, Materov, & Schmidt, 1982).

The types of efficiency described by Farrell (1957), which stated that efficiency can be divided into technical efficiency and allocation efficiency. Technical efficiency is the ability of the company to produce a maximum output of several numbers of inputs. While allocation efficiency is the ability of the company to optimize input usage by considering the input price. The combination of technical efficiency and allocation efficiency is often referred to by the term economic efficiency.

2.4. Stochastic Frontier Function

The Frontier's production function illustrates the maximum output that can be generated with several numbers of production input combinations used. Frontier production functions were first developed by Aigner, Lovell, and Schmidt (1977) and Meeusen and Van Den Broeck (1977). Specification functions are determined through data cross-section with an error term that has two components. One is due to the random effects and others due to technical inefficiencies.

Farrell (1957), expressed technical efficiency describing the company's ability to produce a maximum output of any available input usage. More technical efficiency refers to the possibility to maximize output with the availability of several inputs. Common forms of the Stochastic frontier functions as follows (Coelli, Rao, O'Donnell, & Battes, 2005);

$$Y_i = f(X_{1i}\beta)\varepsilon^{\varepsilon i} \quad (1)$$

where, Y_i =output generated by i observation; X_{li} = L input vector used by i observation; β = coefficient parameter vector; ε_i= Error term of i observation; i = 1, 2, ..., n; and l = 1, 2, ..., L. Error term of i observation is often written v_i - u_i.

Stochastic frontier production function has an error ε_i, So it is often called a model composed error. The error term is composed of two elements, namely the error vi and ui. Each error term has a different distribution. Error term v_i describes the error output variation caused by internal factors, ie factors that can be managed by the manufacturer. Its distribution is assumed to be asymmetric and half-normal distribution. Thus variants are;

$$\sigma^2 = \sigma^2 v + \sigma^2 u \quad (2)$$

According to Battese (1992), the total variation of the actual output to its frontier is;

$$\gamma = \frac{\sigma_v^2}{\sigma} \quad (3)$$

While Jondrow et al. (1982), measuring the level of technical efficiency as follows;

$$TE_i = \exp[-E(u_i/\varepsilon_i)] \quad (4)$$

$$\text{with } E(u_i/\varepsilon_i) = \frac{\sigma_v^2}{\sigma}\left[\frac{f(\mathcal{E}_i\lambda/\sigma)}{1-F(\varepsilon_i\lambda/\sigma)} - \frac{\varepsilon_i\lambda}{\sigma}\right] \quad (5)$$

Where, $f(\varepsilon_i\lambda/\sigma)$ = Standard density function normally; $F(\varepsilon_i\lambda/\sigma)$= Standard normal distribution function, thus $0 \leq TE_i \leq 1$.

Nurlela (2015) in his research on the efficiency and productivity of small business chips in Sorong City, using a model of multiple linear regression between the variables of capital, labor, and fuel to the industrial chips/output; Find variable capital and labor influence positive to the industrial output of chips. While the fuel variable is related to negative with chips/output. The results of this study indicate that the utilization of capital and labor in the chips industry is efficient. As for fuel, the utilization is not yet efficient.

Research conducted by Wajdi (2012)), regarding the efficiency of small industries in Central Java with a stochastic frontier model using output variables, manpower, and capital. Found that the most of efficient small industry sectors are handicrafts. The results of the calculation of the technical efficiency of the whole small industry in Central Java belong to the efficient category. It is not separated from the application of technology, utilization of human resource management, marketing optimization and conducive business climate.

Meanwhile, Asmara, Hanani, and Irawati (2011), in their research on the technical efficiency of the industry MOCAF Chips in Trenggalek District, using the stochastic frontier approach, found

almost all the business units manufacture MOCAF Chips already efficient technically. The factors that have a real impact on technical efficiency are the level of education, ownership, and length of effort. Therefore, increasing the level of education must be kept, so that technical efficiency can still be maintained. On the other hand, research conducted by Noor and Ismail (2007), found 95 small and medium industries in Malaysia have not been efficient. The main source of inefficiency is the scale of production that is not optimal and excessive input factors.

The study of technical efficiency in the pharmaceutical industry in Indonesia using the Stochastic Frontier approach by Minangsari, Robiani, & Mukhlis, (2019), found that the pharmaceutical industry has not reached an optimal level of efficiency due to the use of imported raw materials that still dominate and the low quality of the workforce.

3. MATERIALS AND METHODS

This research was conducted in South Sumatera Province in 2019 with the research object is a cracker industry that is part of the food industry. Reason to choose this type of industry because this type of industry is dominant in South Sumatera province, visible from the number of business units, labor absorption, and the value of investments to total existing small industries.

The data used is secondary data with the number of business units, capital, output, and manpower, obtained from the Department of Industry and Trade of South Sumatra province and the Central Bureau of Statistics South Sumatera province. The method of data collection is done by documentation methods and literature study, both in the form of scientific articles and other information relevant to this research.

The technical efficiency of the cracker industry in this study was estimated using the production model of Stochastic Frontier Analysis (SFA) (Coelli, Rao, et al., 2005). This stochastic production Model is used to look at the relationship between capital and Labor. This function is formed in the Cobb-Douglas function as follows;

$$Q_i = \beta_1 + \beta_2 K_i + \beta_3 L_i + v_i + u_i \quad (6)$$

The equation above was modified in the form of the natural logarithm (Ln), and rewritten;

$$\ln Q_i = \beta_1 + \beta_2 \beta \ln K_i + \beta_3 \ln L_i + v_i + u_i \quad (7)$$

Where Q_i is output; K_i is capital; L_i is labor; v_i si error term models; and u_i is one-side error term (representing technical inefficiency).

Error term u_i is considered negative and increases due to normal distribution cuts with zero averages and positive σu^2 variances. In other words, the error term v_i is assumed to have a normal distribution with a zero average and a positive σu^2 variance. This illustrates the measurement errors associated with factors out of control, which are found in the production process. The value of technical efficiency can be known from the results of data processing with the Frontier Program (version 4.1. c). Justification of the efficiency value is, if the value of technical efficiency is equal to one, then the use of inputs in production is already efficient, and vice versa (Coelli, Rao, et al., 2005).

Hypothesis test results of the estimation is done by using likelihood ratio test (LR test) as follows;

$H_o = \sigma_u^2 = 0$ (there is no effect of inefficiency on output)

$H_1 = \sigma_u^2 > 0$ (there is an effect of inefficiency on output)

The formula of LR test shown as follows;

$$LR = -2[\ln L_r - \ln L_u \quad (8)$$

Where LR is likelihood ratio; L_r is value L_r at OLS approach; and L_u is value L_u at Maximum Likelihood Estimation (MLE) approach.

Furthermore, the value of LR will be compared to the critical value χ^2 (Kodde & Palm, 1986). Technical production model with MLE method used to calculate the technical efficiency (Coelli, Rao, et al., 2005).

4. RESULTS AND DISCUSSION

Efficiency is one aspect of measuring industrial performance when the industry uses inputs to produce output. The stochastic frontier model can be used to figure out the relationship between outputs with production inputs. The estimation using a stochastic frontier in this study, first conducted by conducting data transformation in the form of natural logarithmic (Ln). Variables used are variable Output (Q_i), Labor (L_i), and Capital (C_i).

Based on the results of the estimate, the factor of capital and labor productivity is influential positivity on the production of the crackers industry with a confidence level of 99 percent. This is demonstrated by the results of capital (C_i) variable and labor variable (Li), respectively at 9.7122979 and 3.4921811, and the value is greater than the T-table value of 1.660.

The Sigma-square (s) and gamma (γ) values derived from the estimation with the Maximum Likelihood Estimation (MLE) method are 4.3822418 and 0.83540655, and significantly on the one percent level. The Sigma-squared (s) value greater than zero indicates there is a technical inefficiency influence in the model. This is in accordance with the literature that mentions, when the value of s = 0, then there is no influence of technical inefficiencies (Coelli, Prasada Rao, O'Donnell, & Battese, 2005).

Table 1. The frontier production estimate results

Variable	MLE (*Maximum Likelihood Estimation*)		
	Coefficient	**Standard-error**	**t-ratio**
Constant	4.3422230	0.4470850	9.7122979***
LnC_i	0.1773377	0.0507813	3.4921811***
LnL_i	0.7726787	0.0980934	7.8769628***
sigma-squared (s)	4.3822418	2.1430940	2.0448202***
gamma (γ)	0.8354065	0.0870765	9.5939303***
log likelihood function = -59.177641			
LR test of the one-sided error = 8.981; (LR table = 6.635)			
mean eff. in year 1 = 0.57386216			
Level significant 5%			
t-table (5%, 398) = 1,660**			
t-table (1%, 398) = 2,364***			

Source: Authors calculation

The gamma value (γ) indicates the variation of the fault caused by the technical inefficiency component. The result of the calculation obtained a gamma (γ) value of 0.83540655. This indicates the variation in the error value caused by the high technical inefficiency component, which is 83.5 percent. That is, there is a difference between actual production and maximum production caused by technical inefficiency effect, not by other factors that are not in the model.

The LR value (Likelihood Ratio) test is based on the calculations obtained at 8.981. Hereinafter compared to χ^2 of the LR table of 6.635. This value is smaller than the LR test value. Thus, H_0 rejected and H_1 accepted, so the value is $\Sigma U_2 > 0$. It can be concluded there is an effect of inefficiency on the output so that most of the cracker industry in South Sumatra has not achieved a 100 percent efficiency level.

Based on the calculation result, the value of the positive coefficient is obtained from the modal and labor variables. This indicates that both variables have a direct connection to the production, although the resulting effect is different. The impact of capital on production amounted to 0.17733776 and is significant at one percent level. That is, if the capital plus one percent, the production will increase by 0.17733776 percent. The impact of the workforce is 0.77267875 and is

significant at one percent level; Indicates that if there is a one percent increase in labor, it increases the production by 0.77267875 percent. The effect shows, comparatively, the labor factor for production is more effective than the capital. This can be understood because the cracker industry in South Sumatera still uses work-intensive technology that utilizes the available workforce. Therefore, the addition of capital and workers without being followed by increased technology utilization, skill enhancement, and solutions to the barriers of industrial development such as the difficulty of access raw materials, and then will not be able to increase the output Companies in small industries.

Theoretically, the industry with a high level of efficiency has a great ability to suppress production costs. Meanwhile, technology and human resource skills are an important element in the activity of the industry. Therefore, the development of the crackers industry through an efficiency approach cannot be separated from the application of technology, human resource management, marketing, and business climate.

Based on the calculation result with MLE method, the average value of technical efficiency is obtained overall of 0.57386216. This shows, overall the cracker industry in South Sumatera is in a low category and has not achieved optimal efficiency level. The average value of technical efficiency is 0.57386216, meaning to achieve an efficiency of 100 percent, the cracker industry must increase its output by 42.61 percent, using the same input.

Three factors that affect the achievement of output, namely the efficiency of the use of inputs, the technology usage factor, and the input factor (Kumbhakar, Ghosh, & McGuckin, 1991). Thus the level of efficiency of the crackers industry in South Sumatera is low can be sourced from three factors: 1) Efficiency of the use of inputs, namely physical capital and workers; 2) Utilization of technology, although still low, but its use for the production is quite efficient, and 3) The use of capital and labor input factors. There is a tendency for manufacturers to rate too low in evaluating the magnitude of the capital, so that the output value looks higher or more efficient, or otherwise the capital is considered too high, so the output value looks lower.

5. CONCLUSIONS

The achievement of the technical efficiency of the crackers industry in South Sumatera is in a low or inefficient category. The role of labor in the small industry of crackers is relatively greater than the capital. This is due to the small industry of crackers in South Sumatera still use work-intensive technology, based on the utilization of manpower available.

The increase in the effectiveness of the cracker industry in South Sumatera is not limited to the provision of capital. But it should be followed with the increased skills and mastery of technology for entrepreneurs and workers in small industries. To improve productivity in real life, technological innovation or more advanced equipment is needed. However, this is not easy, as it requires groundbreaking technologies that are usually expected of research activities.

Looking at the value of output and inefficiency of the crackers industry as a whole, implies the increasingly urgent need for a change in the orientation of its development policy. The pattern of partnership with large businesses must be in a cluster scheme. So that there is guaranteed ease of access to finance, marketing, technology utilization, and access to raw materials. So that small industries can produce more efficiently and be able to compete in the global market.

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