TECHNICAL EFFICIENCY ANALYSIS IN INDONESIAN FISHERY PROCESSING INDUSTRY: A CASE OF FISHERY CANNED PRODUCT FIRMS

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Abstract. This study aims to analyze technical efficiency and evaluate the effect of some sources of inefficiency in the Indonesian fishery canned firms during the period of 1990-2015. We calculate technical efficiency using the Stochastic Frontier Analysis (SFA) method with Time Varying Decay. The average of technical efficiency in this industry during the period of 1990-2015 was only 57%. It indicates that firms in this industry still encounter a problem in allocating the resources in efficient manner. However, during the period of 1994-2015, the efficiency in the Indonesian fishery canned industry has declined. We also employed the Ordinary Least Square (OLS) method to evaluate the sources of inefficiency. The results showed that eight variables affected to the efficiency in this industry, thereby it will reduce fishery product competitiveness in the future.

Keywords : Technical efficiency, stochastic frontier analysis, Indonesian fishery canned firms

Abstrak. Penelitian ini bertujuan untuk menganalisis efisiensi teknis dan mengevaluasi pengaruh beberapa sumber inefisiensi dalam perusahaan pengalengan ikan Indonesia selama periode 1990-2015. Studi menghitung efisiensi teknis menggunakan metode *Stochastic Frontier Analysis* (SFA) dengan *Time Varying Decay*. Rata-rata efisiensi teknis di industri pengalengan ikan Indonesia pada tahun 1990-2015 hanya 57%. Ini menunjukkan bahwa perusahaan-perusahaan dalam industri ini masih menghadapi masalah dalam mengalokasikan sumber daya secara efisien. Selama periode 1994-2015, efisiensi di industri ini cenderung menurun. Hasil penelitian juga menemukan bahwa 8 peubah yang dievaluasi berpengaruh signifikan terhadap inefisiensi. Temuan ini berdampak pada daya saing industri pengelangan ikan di masa yang akan datang.

Kata Kunci: Efisiensi teknis, *stochastic frontier analysis,* perusahaan pengalengan ikan Indonesia

INTRODUCTION

Fish Processing Industry is among the downstream industry which has been expected to become prime mover for Indonesian economic growth. Industrial downstreaming policy has become the special intention of the Indonesian government since 2010, but the contribution to the national income is still very limited. The utilization of downstream industries has not contributed significantly to the national income, because the utilization level is only 50% (Ministry of Industry, 2016). Furthermore, Indonesian Fishery Processing Industry (IFPI) is very important because processing can be one way to increase value added of fishery products and is expected to be one strategic effort to elevate the competitiveness of the country in respect to ASEAN Economic Community policy. This study is also in line with the development plan of 2015, which is to strengthen the development of maritime-based industries.

Based on the Industrial Standard International Classification (ISIC) released by the BPS Statistics of Indonesian (BPS), IFPI is classified into 6 sub industrial categories namely ISIC code 15121 is for the canned product, 15122 is for the salted product, 15123 is for the smoked product, 15124 is for the frozen product, 15125 is for processed product, and 15129 is for the other products.

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

The fish canned product is very potential commodity in the context of IFPI for three main reasons. Firstly, among the five type of fishery product, the canned product have a strict regulation that is starting from 2010 government of Indonesia prohibited export fresh fish. The canned product will be the best alternative industry. Secondly, this industry is also can create more labor creation for population and it can affect to the unemployment rate and reduce poverty, in long term. Thirdly, canned product also becomes one industry which is very potential to increase Indonesian economy due to the fact that most of the canned products are export-oriented. This, in turn, is able to support the Indonesian national income.

Based on the UN Comtrade Database, the total number of export of the fishery canned products/industry coming from Indonesia shows an increasing trend in the period of 2000–2015, despite a little decrease at certain years before 1997. This positive trend indicates that Indonesia is able to fulfill the continuously growing need and the demand of international market. This performance, of course, contributed significantly to the total national income.

Exports of Indonesian Fishery Canned Processing Industry (hereinafter called IFCPI) demonstrated a positive trend. During the period 1990-1998, the average export growth is only 40 percent, but during the period of 1999-2015, it increased 81 percent. The growth of export become 11 times in 1998 due to one dollars to rupiah equal to Rp 11.591,- (on average). Even though, Indonesia is not the biggest exporter of this commodity in Southeast Asia. Based on the data of UN Comrade, the top ranks of fishery canned exporters in Southeast Asia are Thailand followed by the Philippines, while Indonesia is only in the third rank. In fact, Indonesia has larger maritime territory compared to those countries. This fact may indicate that the IFCPI in Indonesia is still left behind of those countries because most of the marine products are sold as raw material (fresh fish from direct fishery farmer without any processing). The government should make a big effort to shift the marketing policy from selling the fresh fish into the processed products in order to increase the value added of the resources. Different with other research that mostly used a Cobb Douglas production function with a cross section data, this study used translog production function and a Time Varying Decay as a new technique to dealing with panel data. This Time Varying Decay (TVD) will give a better information on the score of technical efficiency due to this techniques considers not only cross section but also a time series phenomena, when computing the technical efficiency. The technique of TVD can also identify to technological progress and the study using this technique is still limited. This study is to estimates the technical efficiencies of IFCPI. In the second section, the empirical model for the technical inefficiency effects in the stochastic frontier production function is presented. In this section, the preferred frontier model is determined. Generalized likelihood-ratio tests are conducted to obtain the preferred model for IFCPI. The analyses aim to determine the factors affecting the efficiency in IFCPI. The third section describes the relationship between firm-level technical efficiency with other possible sources of inefficiency using a regression analysis. The fourth section closes with results and discussion and a conclusions.

LITERATURE REVIEW

Stochastic Frontier Analysis: a brief explanation. Stochastic Frontier analysis (SFA) is an analysis used to evaluate two things. First, it is to calculate the level of technical efficiency of a company or industry. This SFA primarily uses a production function to describe the productivity of a company or industry. The interesting aspect in SFA is the production function has two errors. The first error is a random error and it cannot be controlled by the manager of company or organization, while the second error is an error that can be controlled by the manager of a company or organization, We called it as a managerial miss-allocation. In the strategic management science, identifying these such errors are very important to create a new strategies that can be improved competitiveness. The second function of the

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

analysis of technical efficiency using SFA is to evaluate sources of inefficiency. This is also very important, so that managers are also able to take into account the best solution for allocating the resources in efficient manner for the future strategy. By knowing the sources of corporate inefficiencies or company, managers can look for alternatives to existing resources that further improve efficiency and avoid waste.

Efficiency analysis in SFA can be done using firm level data with cross section data or panel data. Research on technical efficiency using cross section data has been carried out and is generally only a case study for one particular sector or industry. Technical efficiency analysis using SFA will be very interesting if it is done for a long series of data in the form of panel data. With a quite long panel data, we can learn about changes in technical efficiency from year to year. In the form of panel data, we can evaluate the presence or absence of technological change as a learning by doing. To analyze technological changes, the method for estimating technical efficiency, we used time varying decay (TVD). TVD is a technique used to estimate the value of efficiency to capture the technological progress that occurs in each company. It is for identifying the learning process in the production every year (Collie *et al.*, 2005). Research using this technique is still fairly rare, especially in the Indonesian fish processing industry.

Research on SFA. Researchs on technical efficiency using stochastic frontier analysis have been done since 1970s. Aigner *et al.,* (1977) and Meeusen and van den Broeck (1977) introduced the use of stochastic frontier model to estimate technical efficiency in manufacturing firms. Since then many authors e.g., Pitt and Lee (1981), Battese and Coelli (1988) and Kumbhakar (1990) extended their analysis to the panel data. In the field of industry, efficiency can be measured by various methods. Ariyanto (2015) used the Weibull distribution to calculate cost efficiency at PT Gajah Tunggal Tbk to test on the motorbike. This research showed that the use of the Weibull distribution can help in determining the reliability of preventive engine parts that have an impact on improving engine maintenance cost efficiency. Suharyadi and Sumarto (2017) conducted an efficiency analysis on the Indonesian Banking industry using the parametric distribution free approach method. Sparta (2016) used stochastic Frontier analysis to calculate banking efficiency in Indonesia by using the bank population of 1177 companies during the period 2001 to 2011. With 107 banks in the sample the empirical results of this study indicate that bank efficiency is significantly positively affected by the growth of gross domestic product and last year's efficiency level and is significantly negatively affected by bank risk. Sukandar *et al.*, 2018 examined the efficiency of construction companies in Indonesia using data envelopment analysis (DEA). Using data from 2010 to 2016 obtained from the Indonesia Stock Exchange, the results of the study showed that state-owned enterprises are more efficient than private companies. This is due to the large number and value of projects and from the government in infrastructure. This research has important implications for the government to prepare state-owned companies to remain efficient but remain profitable when facing competition from foreign companies.

Yapa and Neil (2010) analyzed technical efficiency and total factor productivity from Sri Lanka's manufacturing productivity during a period of regime shift from import substituting industrialization to export oriented industrialization. They used a varying coefficients stochastic production frontier model on a balanced panel data set to shed light on the effects of trade liberalization on Total Factor Productivity which incorporates both changes in Technical Efficiency and Technical Progress.

Coto-Millán *et al.,* (2018) evaluated the determinants of the European electricity companies efficiency using stochastic frontier analysis for 4,639 companies, located in 26 European countries, over the 2009–2014 period. The finding stated that it would be advisable, for all electricity subsectors, to reduce the level of indebtedness and to increase the firm size in order to enhance the

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

efficiency levels. The results also show how the activity diversification and the company age affect firms' performance depending on the subsector.
Gong (2018) analyzed a series of fundamental and market-oriented reforms since 1978 have dramatically reshaped China's agricultural sector during the socialist period. The findings are productivity growth and efficiency changes, the shape of the production function may also transform rapidly over time. Gong also found that the four segments in agriculture (farming, forestry, animal husbandry, and fisheries) have different production processes and techniques, so the aggregated production function of agriculture may vary across provinces.

Novelty of this research. Analysis of technical efficiency in manufacturing industry have been done for many researchers, but analysis of technical efficiency in fishery product are very limited, particularly analysis in details up to 5 digit of ISIC Code. Research on efficiency using a Cobb Douglas production function was very extended in many areas but research on efficiency using a Translog production function was very limited. The time varying decay to estimate the technical efficiency with unbalanced data is also very limited.

METHOD

Data. Secondary data from the Large and Medium Manufacturing Industry Survey from 1990-2015 compiled by the BPS Statistics Indonesia is used. The data used are from a ISIC code number 15121. It is a sub-industry of the Indonesian Fishery Canned Processing Industry (IFCPI).

Analysis was carried out using software of STATA Version 9. The data panel used to evaluate technical efficiency in the model. The data panel is indicated by a unique number called psid. The number of firms to be analyzed is 1,020 observations in 193 firms (cross section data) and 26 years (a time series from 1990 to 2015). Figure 1 shows that the number of IFCPI tends to increase.

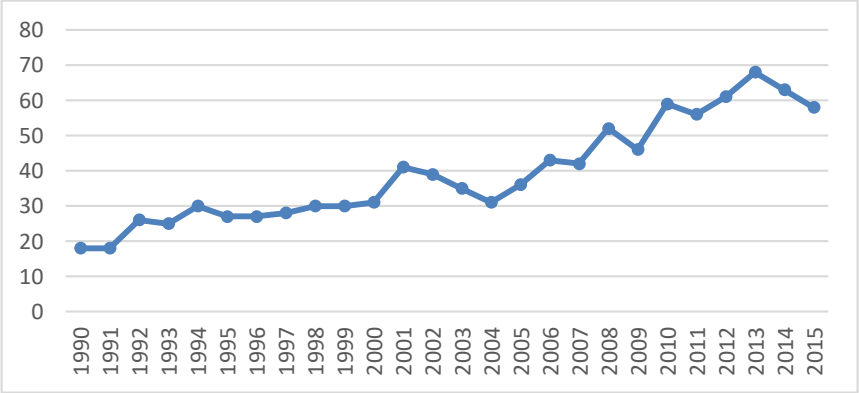

Figure 1. Trend of Number of Firms In IFCPI

Variables Used. Variables used in the production function analysis are output, capital, labor and raw material. Variables used to evaluate the sources of inefficiency are capital intensity ratio, age or length of firms operation, capital ownership, export orientation, size of firms, proportion of the value of imported, type of industry, and market share. The firm-level data distribution during the period of 1990 to 2015 are as depicted by Table 1.

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

Table 1. Number of Firms Used in This Research

Year	No of Firms	Percent	Cummulatif
1990	18	1.76	1.76
1991	18	1.76	3.53
1992	26	2.55	6.08
1993	25	2.45	8.53
1994	30	2.94	11.47
1995	27	2.65	14.12
1996	27	2.65	16.76
1997	28	2.75	19.51
1998	30	2.94	22.45
1999	30	2.94	25.39
2000	31	3.04	28.43
2001	41	4.02	32.45
2002	39	3.82	36.27
2003	35	3.43	39.71
2004	31	3.04	42.75
2005	36	3.53	46.27
2006	43	4.22	50.49
2007	42	4.12	54.61
2008	52	5.1	59.71
2009	46	4.51	64.22
2010	59	5.78	70
2011	56	5.49	75.49
2012	61	5.98	81.47
2013	68	6.67	88.14
2014	63	6.18	94.31
2015	58	5.69	100
Total	1,020	100	

Sources: BPS, Annual Manufacturing Survey compilation by the author

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

Model Used. We construct three steps for the efficiency analysis as follows.

Step 1: Selection of the best model for the efficiency analysis
In this step, there are three types of model to be considered in efficiency analysis modelling, namely translogarithmic model (translog). No translog, and Cobb Douglas Model.

Model 1: Translog

The equation of translog model is as follows

$$\ln Yit = \beta_0 + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_R \ln R_{it} + \beta_T t + \beta_{LL} 0.5*(\ln L_{it}^2) + \beta_{KK} 0.5*(\ln K_{it}^2) + \beta_{RR} 0.5*(\ln R_{it}^2) + \beta_{TT} 0.5*t^2 + \beta_{LK} \ln L_{it}*\ln K_{it} + \beta_{LR} \ln L_{it}*\ln R_{it} + \beta_{KR} \ln K_{it}*\ln R_{it} + \beta_{LT} t*\ln L_{it} + \beta_{KT} t*\ln K_{it} + \beta_{RT} t*\ln R_{it} + U_i - V_i$$

This model is the most complete model and is used to see the technological progress in an industry. The technological progress is proxied by time variable.

Model 2: No Translog

This no translog model is a model describing no technological progress. In this model, variable of time is not present. The equation of no translog model is as follows

$$\ln Y_{it} = \beta_0 + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_R \ln R_{it} + \beta_{LL} 0.5*(\ln L_{it}^2) + \beta_{KK} 0.5*(\ln K_{it}^2) + \beta_{RR} 0.5*(\ln R_{it}^2) + \beta_{LK} \ln L_{it}*\ln K_{it} + \beta_{LR} \ln L_{it}*\ln R_{it} + \beta_{KR} \ln K_{it}*\ln Rit + U_i - V_i$$

Where:
Y = Total Production (in billion rupiahs)
L = Total Labor (number of peoples)
K = Capital (in billion rupiahs)
R = Raw Materials (fish, oil, cans and cooking ingredients)
V = Random Error
U = One sided error (company technical inefficiency)

In this model, the output is used as the dependent variable of the model while Labor (L), Capital (K) and Raw Materia (R) as independent variables of the model. At this stage, we will get the efficiency value of each company in the industry. Output and all input factors are in the form of natural logarithmic.

Model 3: Model Cobb Douglas

The equation of Cobb Douglas is as follow

$$\ln Y_{it} = \beta_0 + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_R \ln R_{it} + U_i - V_i$$

In this model, the Cob Douglas function is used and this model is the simplest compared to other models where the parameters used are only the three variables, namely capital, labor, and raw materials.

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

The selection of a suitable model for this data set of fishery canned products/industry (15121 of ISIC code) used the Generalized Likelihood Ratio Test, when comparing the three models. The translog model is positioned as a reference comparison model for the other two models. The translog model is considered the most complex model. Comparison of the three models is done by comparing the value of λ [-2 (another Likelihood model – Likelihood of reference comparison model)] with the Chi Square table value with the degree of freedom seen from the model retention of the comparison model.

After finding the best model of those three, we chose one as best model and used it to calculate technical efficiency. After we have technical efficiency, we employed it as dependent variable and regress it with 8 independent variables to see whether there is an influence to technical efficiency or not. We use a regression model to evaluate the sources of inefficiency in IFCPI.

Step 2: Calculating Technical Efficiency Values

After finding the most appropriate model to measures the efficiency, we employed the SFA estimation using equation 4 as follow:.

$$\ln Yit = \beta_0 + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_R \ln R_{it} + \beta_T t + \beta_{LL} 0.5*(\ln L_{it}^2) + \beta_{KK} 0.5*(\ln K_{it}^2) + \beta_{RR} 0.5*(\ln R_{it}^2) + \beta_{TT} 0.5*t^2 + \beta_{LK} \ln L_{it}*\ln K_{it} + \beta_{LR} \ln L_{it}*\ln R_{it} + \beta_{KR} \ln K_{it}*\ln R_{it} + \beta_{LT} t*\ln L_{it} + \beta_{KT} t*\ln k_{it} + \beta_{RT} t*\ln \mathbf{R}_{it} + U_i - V_i$$

On the basis of equation (4), the average value or model value of f(u|) can be used to estimate technical efficiency for each producer which can be expressed in the form of:

$$E(u_i|\varepsilon_i|) = \sigma_* \left[\frac{\breve{u}_i}{\sigma_*} + \frac{\phi(\breve{u}_i / \sigma_*)}{1-\phi(\breve{u}_i / \sigma_*)} \right]$$

The point estimation of for the technique efficiency of each firm is in a normal truncated model is

$$TE_i = E(\exp(-u_i|\varepsilon_i) = \frac{1-\phi[\sigma_*-(\breve{u}_i / \sigma_*)]}{1-\phi(\breve{u}_i / \sigma_*)} . \exp\{-u_i + \frac{\breve{1}}{2}\sigma_*^2\}$$

According to Battese and Coellli (1992), the effect of technical inefficiency is the result of multiplying exponential functions of time with random variables from non-negative business characteristics that are formulated in the form of:

$$u_{it} = \{exp[-\eta(t-T)]\}u_i$$

Where η is a parameter that describes the level of change in technical inefficiency. If η is positive then there is an increase in technical efficiency. Based on the estimated product function, the technical efficiency for the first company in the t-observation can be calculated as follows:

$$TE_{it} = \exp(-u_{it})$$

Step 3: Regression Analysis

After estimating some parameters of the best model, we will get the value of technical efficiency of each company in the industry over years. After that, to see the effect of some sources on efficiency in the IFCPI, a regression analysis using the Ordinary Least Square (OLS) must be carried out. The regression model as follow.

$$TE_{it} = \alpha_0 + \alpha_1 CI + \alpha_2 AGE + \alpha_3 PMDN + \alpha_4 ORIEN + \alpha_5 TINDUS + \alpha_6 SIZE + \alpha_7 PIMPOR + \alpha_8 MSHARE + E$$

where:

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

CI	:	Capital intensity ratio. It compute in logarithm of capital (in thousands Rupiahs divided by labor (the total number of paid laborers)
AGE		length of firm operation (in years)
PMDN		capitalization status (1 if the capitalization from domestic, 0 if capitalization from foreign)
ORIEN		export orientation. ORIEN equals to 1 if the export value > 0, ORIEN equals to 0 if export value = 0
TINDUS		Type of Industry (1= large 0=Medium)
SIZE		Size of firms (logarithmic of value added (in thousands of Rupiahs))
PIMPOR	o	the proportion of the value of imported raw materials to the total input
MSHARE	:	Market share
		The formula $MShare = \frac{1}{Total\ Sales}(\sum_{i=0}^{n} Sales - i)$
E	:	random error

RESULTS AND DISCUSSION

Results

Data Description. Table 2 presents the descriptive statistics of the Indonesian fish canned industry. The average production value (output) in the Indonesian fish canned industry in 1990-2015 was 60,3 billion rupiah with standard deviation value of 162 billion rupiahs and minimum value and maxmimum value of output are 33 million and 2.910 billion rupiahs respectively . This high output value shows a high level of differences in productivity between companies.

The average value of capital is equal to 6,5 billion rupiahs, The standard deviation is 14 billion rupaihs. The the minimum capital value of all companies amounting to 5 million rupiah. This minimum value indicates that there are several companies that have a value that is very far from the overall company average. The maximum value of capital in this industry is 176 billion rupiahs.

Average raw material variable in the Indonesian fish canned industry is 35,2 billion rupiahs eith standard deviation is 96 billion rupiahs and cost of raw material reach the maximum of 1,420 billion rupiahs . For labor variables in this industry, the minimum number of workers in companies in the fish canned industry is 20 people, while the maximum number of workers in this industry is 3,020 people. The minimum value of labor as many as 20 people indicating that IFCPI consists only two type of industry. A firm is said to be a medium industry if the number of labor in the firms are from 20 people up to 99 people. A firm is said to be a large industry if the number of labor in the firms are more than 99 people

Table 2. Descriptive Statistics of Variables in The Production Function

Variable	Obs	Mean	Std. Dev.	Min	Max
Output	1020	60,300,000	162,000,000	33,801	2,910,000,000
Capital	1020	6,585,809	14,700,000	5,420	176,000,000
Labor	1020	401	491	20	3,020
raw material	1020	35,200,000	96,700,000	-	1,420,000,000

Sources: BPS, Annual Manufacturing Survey, compilation by the author

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

Descriptive statistics from variables that are sources of inefficiency in IFCPI are shown in Table 3.The average technical efficiency is 57,3% with a standard deviation of 5,8%, and a minimum technical efficiency value of 44,5% and a maximum value of 83,6%. Capital intensity in IFCPI has an average value of 8.84 with a standard deviation of 1.22 and a minimum value of 4.79 and a maximum value of 12.935. The average years of a company operation is around 16 years, with a standard deviation of 9 years and the period of company operation ranges from less than 1 year to 56 years. The size of the company in IFCPI has an average of 14.915 with a standard deviation of 2.103 and a minimum value of 8.817 and a maximum value of 21.122. The proportion of imports in this industry has an average of 5,3% with a standard deviation of 13% and a maximum value of 98.6%. Market Share in this industry has an average of 2.405 with a standard deviation of 5.04 and a maximum value of 54.995

Table 3. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
TE	1,014	0.573	0.058	0.445	0.836
CI	1,020	8.840	1.223	4.793	12.935
AGE	1,020	15.465	9.188	0.000	56.000
PMDN	1,020	0.832	0.374	0.000	1.000
ORIEN	1,020	0.638	0.481	0.000	1.000
TINDUS	1,020	0.679	0.467	0.000	1.000
SIZE	1,020	14.915	2.103	8.817	21.122
PIMPOR	1,020	0.053	0.131	0.000	0.986
MSHARE	1,020	2.405	5.040	0.001	54.995

Sources: BPS, Annual Manufacturing Survey, compilation by the author

There are three dummy variables in this analysis, namely capital ownership, export orientation, and type of industry. Table 4 shows a descriptive statistics for these three variables. The percentage of firms from domestic capital ownership was only 16.76%, the remaining of 83.24% from foreign capital ownership. Firms with no export orientation are only 36.18% and more than a half of the number of firms (63,82%) are from firms with export-oriented. That why, we can say that IFCPI is export oriented industry. Percentage of medium industry is only 32,06% and large industry is 67,94%.

Table 4. Descriptive Statistics of Dummy Variables

Dummy Variables	Freq.	Percent
Capital Ownership		
Foreign	171	16.76
Domestic	849	83.24
Orientation of Export		
No	369	36.18
Yes	651	63.82
Type of Industry		
Medium	327	32.06
Large	693	67.94
Total	1,020	100.00

Sources: BPS, Annual Manufacturing Survey, Compilation by author.

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

Estimation and hypothesis testing. Determination of the best model for this industry data set by conducting a Generalized Likelihood Ratio test. There are three models that will be compared, namely: the Translog model, No Translog, and Cobb Douglass. The selection of the best model from these three models is done by comparing the value of λ with the value of the Chi-Square Table. The value of λ is obtained from -2 [log likelihood model - log likelihood translog model]. The comparison used in this test is the translog model where the translog model is the most complete model compared to other models. The degree of freedom is a comparison of each model. The model that will be compared with the translog model is the no translog model where Ho in this model $\beta_T = \beta_{TT} = \beta_{LT} = \beta_{KT} = \beta_{RT} = 0$. If the value of λ is greater than the Chi Square table value, we will reject the model or reject Ho. This model illustrates that there is no technological progress between times. Likewise with the Cobb Douglass method where Ho in this model $\beta_{ij} = 0$ .When the value λ > of the Chi Square table valuel, we will reject the model or reject Ho. This indicates that Cobb Douglass's simple model was unable to explain this industry data set. After estimating the Log Likelihood value for each model, then the writer will conduct a Generalized Likelihood Ratio test between the three models. It is illustrated in Table 5.

Table 5. Likelihood-ratio tests of hypotheses for parameters of the stochastic frontier production functions technical inefficiency effects in IFCPI, 1990-2015

Model	Hyphotesis	λ	Chisquare (1%)	Conclusion
No Translog	$\beta_T = \beta_{TT} = \beta_{LT} = \beta_{KT} = \beta_{RT} = 0$	161.84	21.66	Rejected Ho
Cobb Douglas	$\beta_{ij} = 0$, i, j =1,2,..	579.23	24.73	Rejected Ho

Sources: BPS, Annual Manufacturing Survey, compilation by the author

Based on the estimation results, it is obtained that the No Translog model is rejected because the value of λ> from the Chi Square value as shown in Table 5 at the significance level of 1%. This indicates that in the data set of the fish canned industry, there is technological progress. Likewise with the Cobb Douglass model where the model is also rejected. From the results of the testing of the 3 models above, the best is the translog model. It is model with the most appropriate model for the data set of the fish canned industry using the SFA method.

Stochastic Frontier Analysis (SFA) Model Translog with Time Varying Decay. After choosing best model, we conduct a time varying decay procedure for computing technical efficiency. Based on Table 6, several comments should be added concerning the parameters. Variables of input factors namely capital, labor and cost of raw materials are the three main components of inputs in IFCPI. The Translog functional form was adequate, but the technical efficiency effects were significant and technical change was not present. The signs of the coefficients of the various variables in the translog stochastic frontier are as expected. The positive coefficients of all the output elasticity measures, being significant at the one percent, five percent and ten percent level of confident, confirm the possibility to increase output by increasing the application of inputs.

Estimation of Paremeters in Stochastic Production Function. The output elasticities of capital estimated to be 1.05, means that, if capital is increased by 10 percent holding all other inputs constant, output can be increased by about 10.5 per cent. The output elasticities of labor estimated to be 0.35, means that, if labor is increased by 10 percent holding all other inputs constant, output can be increased by about 3.5 per cent. The output elasticities of raw material estimated to be 0.18, means that, if raw material is increased by 10 percent holding all other inputs constant, output can be

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

increased by about 1.8 per cent. it is possible to increase the output without having to increase the levels of any input, may be answered by the positive signs of the size of firms, proportion import, and market share coefficient. These positive sign indicating that IFCPI is likely to experience technological progress or an upward shift in the production frontier. The results show that the capital ownership coefficients is negative and significant, which therefore would indicate that the foreign capitalization are more efficient than the domestic capitalization.

The Translog functional form was adequate, but the technical efficiency effects were significant and technical change was present. It means that Translog can be used to see learning by doing process in the firms. The signs of the coefficients of the various variables in the translog stochastic frontier are as expected. The positive coefficients of all the output elasticity measures, being significant at the one percent, five percent and ten percent level of confident, confirm the possibility to increase output by increasing the application of inputs. The output elasticities of capital estimated to be 1.05, means that, if capital is increased by 10 percent holding all other inputs constant, output can be increased by about 10.5 per cent. The output elasticities of labor estimated to be 0.35, means that, if labor is increased by 10 percent holding all other inputs constant, output can be increased by about 3.5 per cent. The output elasticities of raw material estimated to be 0.18, means that, if raw material is increased by 10 percent holding all other inputs constant, output can be increased by about 1.8 per cent.

The coefficient related to the export orientation is negative and very highly significant. It imply that firms with an orientation export are more efficient than those firms which no export orientation. The results also shows that that firms with a higher proportion of imported raw materials tend to be more efficient than those with smaller proportions of imported raw materials. The coefficient of proportion of domestic to total cost of raw materials is positive and very highly significant.

The important estimate which is probably the more relevant in context of this efficiency study is the variance ratio, γ. The variance ratio is very small (0.19). However, as indicated in the discussion of Table 6, the likelihood-ratio tests indicate that the technical inefficiency effect is statistically significant. The t-test is critically dependent on the estimated standard errors of the maximum likelihood estimators which often are quite large. The likelihood-ratio test is preferred because they only depend on the values of the likelihood function under the null and alternative hypotheses. The value of η in the stochastic frontier analysis very low of -0.01 and it is significant in level of significance 95%. It means, that it will be a decreasing trend on the efficiency.

From Table 6, it can be said that in 192 firms in panel data, the number of firms that can be computed its efficiency is only 1,014 firms and 6 firms cannot be computed due to a missing value in raw material.

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Table 6. Estimation of Paremeters in Stochastic Production Function Using Time Varying Decay (TVD)

Variables	Parameter	Coef	Std err	z	P>z	Sign[1)]
Capital	β_K	1.05	0.12	8.67	0.00	***
Labor	β_L	0.35	0.15	2.32	0.02	**
Material	β_R	0.18	0.10	1.89	0.06	*
Time	β_T	-0.11	0.19	-0.60	0.55	
0.5*(capital)^2	β_{KK}	0.14	0.02	7.58	0.00	***
0.5*(labor) ^{2}	β_{LL}	0.06	0.04	1.78	0.08	*
0.5*(material) ^{2}	β_{RR}	0.22	0.01	19.28	0.00	***
time*time	β_{TT}	0.28	0.04	6.69	0.00	***
capital*labor	β_{KL}	0.00	0.02	0.15	0.88	
capital*material	β_{KR}	-0.18	0.01	-15.71	0.00	***
capital*time	β_{KT}	0.01	0.03	0.44	0.66	
labor*material	β_{LR}	-0.06	0.02	-3.68	0.00	***
labor*time	β_{LT}	0.12	0.03	4.35	0.00	***
material*time	β_{rt}	-0.07	0.02	-3.32	0.00	***
Constant	β_0	-0.33	0.69	-0.48	0.63	
/mu	μ	0.59	0.26	2.23	0.03	
/eta	η	-0.01	0.01	-0.87	0.39	**
/lnsigma2	$\ln\sigma^2$	-2.14	0.06	-36.04	0.00	***
/ilgtgamma	$L\eta\gamma$	-1.42	0.34	-4.15	0.00	***
sigma2	$\sigma 2$	0.12	0.01			
gamma	Γ	0.19	0.05			
sigma_u2	u^2	0.02	0.01			
sigma_v2	v^2	0.09	0.00			

No of observation =1,014

No of groups = 192

Log likehood = -304.42486

Sign ***) significance at 99% level of confident

**) significance at 95% level of confident

*) significance at 90% level of confident

Table 7 shows the average technical efficiency from the year of 1990 up to 2015.. On average, technical efficiency in IFCPI tends to decrease year by year.

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Table 7. Technical `Efficiency Over 26 Years in IFCPI

Year	No of Firms	Technial Efficiency
1990	18	0.60
1991	18	0.59
1992	26	0.61
1993	25	0.61
1994	30	0.60
1995	27	0.60
1996	27	0.60
1997	28	0.60
1998	30	0.59
1999	30	0.58
2000	31	0.58
2001	41	0.56
2002	39	0.57
2003	35	0.58
2004	31	0.58
2005	36	0.57
2006	43	0.57
2007	42	0.56
2008	52	0.56
2009	46	0.56
2010	59	0.57
2011	56	0.57
2012	61	0.56
2013	68	0.56
2014	63	0.55
2015	58	0.56
Total	1,020	0.57

Sources: BPS, Annual Manufacturing Survey, compilation by the author

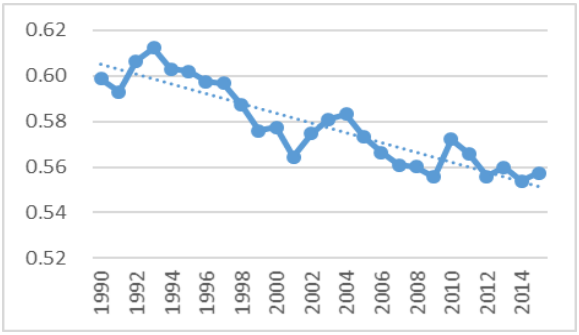

Figure 2. Trend of Technical Efficiency in IFCPI

Table 8 shows the average technical efficiency grouped by dummy variables and time period. On average, companies with foreign capital status are slightly higher in technical efficiency compared

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

to companies to domestic capital status. There is no differences on average of technical efficiency between companies with the export orientation and non-export companies. This pattern occurs in medium and large companies, that is average of technical efficiency of medium companies is not different compared to technical efficiency of large companies

Table 8. Technical `Efficiency by dummy variables and period of time

Variable	1990-1993	1994-1996	1997-1999	2000-2003	2004-2008	2009-2013	2014-2015	Average
Capitalization Status								
Foreign	0.62	0.63	0.65	0.63	0.61	0.58	0.56	0.61
Domestic	0.60	0.59	0.57	0.56	0.56	0.56	0.55	0.57
Export Orientation								
Non export orientation	0.60	0.59	0.58	0.57	0.57	0.55	n.a	0.58
Export orientation	0.61	0.61	0.59	0.58	0.57	0.56	0.56	0.57
Type of Industry								
Medium	0.60	0.59	0.56	0.55	0.56	0.57	0.56	0.57
Large	0.60	0.60	0.60	0.59	0.57	0.56	0.55	0.58
Average	0.60	0.60	0.59	0.57	0.57	0.56	0.56	0.57

Sources: BPS, Annual Manufacturing Survey, compilation by the author

Technical Efficiency: a time series comparison. Analysis of technical efficiency will be more interesting if we can distinguish changes in technical efficiency over years to see the development of learning by doing firms. Figure 3 shows the trend of technical efficiency by industry types, namely medium and large industries. The development of technical efficiency of these two types of industries are not different during the first 8 years of the period from 1990 until 1997. Firms in the middle-sized industry have a lower technical efficiency compared to firms in large-sized industry. The growth of technical efficiency of middle and large size industry tended to be the same after 2003 up to 2015..

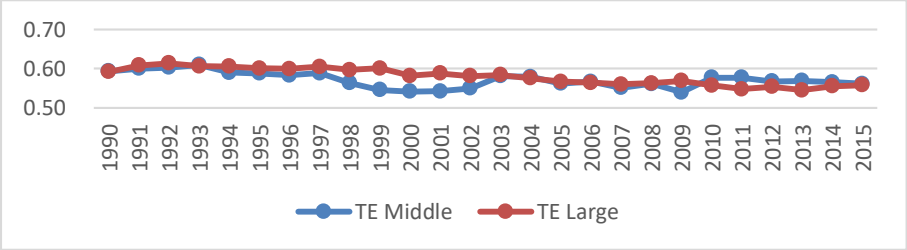

Figure 3. Trend of Technical Efficiency by Type of Industry

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Figure 4 shows the trend of technical efficiency related to export orientation of companies. The development of technical efficiency in non-export-oriented companies tended to be lower than those of export orientation companies from 2001 to 2015.

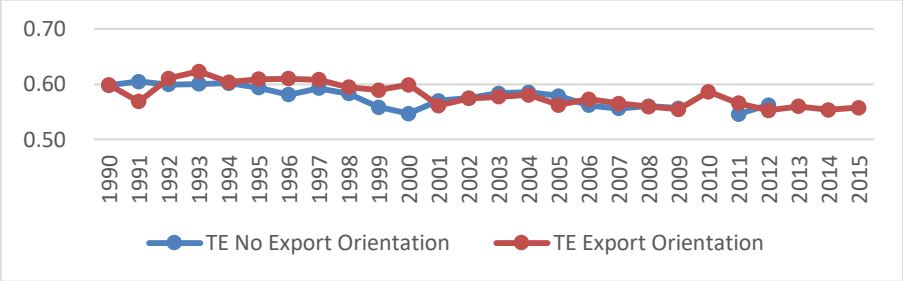

Figure 4. Trend of Technical Efficiency by Export Orientation

Figure 5 shows the trend of technical efficiency related to capital ownership. The development of the analysis of technical efficiency according to capital ownership shows that foreign capital ownership are far more efficient compared to domestic capital ownership, even though in 1991 a foreign capital ownership was lower than a domestic capital ownership industry.

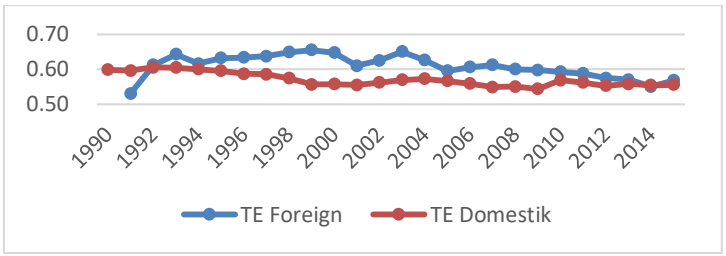

Figure 5. Trend of Technical Efficiency by Capital Ownership

Sources of technical inefficiency. The estimated coefficients in the technical inefficiency model are of particular interest to this study. This study examines several hypotheses drawn from the literature on micro-economic analysis, industrial development and policies in developing countries, in so far as they are relevant in Indonesia case and possibly influence efficiency of firms. This section, based on the results of the estimation of the inefficiency model in the stochastic frontier, as shown in Table 10, quantitatively demonstrates the importance of the relationship between the characteristics of firms and technical inefficiency.

Based on the model shown in Table 9, it is known that all independent variables used to see the effect on technical efficiency are significantly affect technical efficiency. Capital intensity in fish processing industry having a negative influence on technical efficiency with a regression coefficient of -0.0011 (with a level of significant 99%). This means that the higher the use of capital towards labor will reduce efficiency. The age of the company in the fish canned industry has a positive influence on technical efficiency (with a level of significant 90%). The status of capital ownership has a negative regression coefficient of -0.023 and has an effect on technical efficiency (with a level of significant 99%). This means that the status of foreign capital ownership is more efficient compared to domestic capital ownership status. Variable export orientation also has a negative influence on technical efficiency with a regression coefficient of -0.007 (with a level of significant 95%) This means that companies that have an export orientation are more efficient than companies that do not have an export orientation. The type of industry affects technical efficiency

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

with a 99% level of significant. Large-scale companies are more efficient than medium-scale companies. Firm size affects technical efficiency positively with a regression coefficient of 0.008 with a confidence level of 99%. this means that the longer the company operates more efficiently due to learning by doing.

Table 9. Regression Model for Sources of Inefficiency

Variables	Coef.		Std. Error	t	P>t
CI	-0.011	***	0.002	-6.780	0.000
AGE	0.000	*	0.000	-1.670	0.095
PMDN	-0.023	***	0.005	-4.570	0.000
ORIEN	-0.007	**	0.004	-2.020	0.044
TINDUS	-0.020	***	0.004	-4.520	0.000
SIZE	0.008	***	0.001	6.070	0.000
PIMPORIN	0.054	***	0.014	3.940	0.000
MSHARE	0.002	***	0.000	6.030	0.000
Constant	0.591	***	0.016	35.830	0.000

Note: Technical Efficiency as the dependent variable
Sources: BPS, Annual ManufacturingSurvey, compilation by the author

The variable proportion of imports influences technical efficiency positively with a regression coefficient of 0.054 with a level of significant 99%. The greater the proportion of imports, the more efficient but there is a consequence of high costs if the proportion of imports exceeds the local content. The market share positively influences technical efficiency with a regression coefficient of 0.002 with a 99% level of significant. This means the greater the market share the more efficient the company is in carrying out its productivity

Discussions. Based on the theory, the use of input factors not only in partial input. The previous studies, only captured the three input factors in Cobb Douglas production function, This research applied translog production function that considered combination of input factors and interaction of input factors. So the situation in the production process of IFCI industry become real and realistic.
Estimates of stochastic production function parameters of this study indicate that elasticity of three input factors namely capital (1.05), labor (035), and raw materials (0.18) are positive and significant at the 1%, 5%, and 10% level of significance respectively. This study shows that input factors play a important role in increasing productivity in IFCI. This study strengthens to what Margono and Sharma (2006) found that elasticity of capital (0.81), labor (0.13), and raw materials (0,56) are not significant. In comparison, the elasticity of input factors in IFCPI is better in reflecting the output of production rather than what is found by Margono and Sharma (2006).

Furthermore, the average score score of technical efficiency in IFCPI during 1990-2015 is 57% and raw material is the main input factor in increasing the productivity. The score of technical efficiency in this research is bigger than what have Margono and Sharma (2006) found in their research related to food industry. According to them, the technical efficiency of food firm is only 50.7%. It seems that there is an improvement in the efficiency matter for food industry, especially in IFCPI.

Capital Intensity is a variable that describes the utility of capital in the production process of each workforce. This variable has a negative and significant coefficient on technical efficiency. In

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

the estimation, an increase in capital intensity of 1 percent, it will decrease technical efficiency by 1.1 percent. This result is not in accordance with the initial hypothesis where high capital intensity can increase productivity. It is not in line with the research of Mazumdar *et al.*, (2009). Based on Mazumdar *et al.*, (2009), and Endri (2010) the effect of capital intensity is positive to the efficiency. Age of firms is positive and significant in increasing efficiency. This results in line with some researchers such as Margono and Sharma (2006) which state that age of firms has a positive effect on technical efficiency. But, the finding that age of firms is positive and significant to increase efficiency is not consistent with Walujadi (2004) that found age of firms is negative and significant. It means that the role of firms' age is still need clarification.

The size of the company in this study has a positive effect on technical efficiency. the greater the size of the company the more technical efficiency increases. The results of this study are also in line with Endri (2018), Kim (2003), and Lundval and Battese (2000). But this study is not in line with study of Margono and Sharma (2006) which states that the size of companies in the food industry has a negative effect on technical efficiency.

Companies with foreign capital ownership are more efficient than firms domestic ownership. This result is not in line with the research of Walujadi (2004). Export-oriented companies are more efficient than companies that do not have export orientation. This finding consistent to the research of Margono and Sharma (2006)

CONCLUSION

Technical efficiency in IFCPI is decreasing from year to year from 1990 to 2015. The score of technical efficiency is computed by stochastic frontier of production function wuth Time Varying Decay techniques. Evaluation on the sources of inefficiency in IFCPI revealed that all the variables significantly affect to the technical efficiency.

Capital intensity has a negative effect on technical efficiency. The age of the company has a positive effect on technical efficiency. Companies with foreign capital ownership are more efficient than firms domestic ownership. Export-oriented companies are more efficient than companies that do not have export orientation. Large-scale companies are more efficient than medium-sized companies. Company size is a source of increased technical efficiency. The import proportion is a source of technical inefficiency because the greater the input proportion the higher the efficiency. Market share is also a source of increased technical efficiency.

There are 2 implications that need to be considered by policy makers, namely related to the intensity of capital which turns out to reduce the level of efficiency. It means that the government must pay special attention to the management of capital intensity in the fish canned industry. Implications related to the proportion of imports that increase efficiency in one side it provide an increased levels of productivity, but on the other side there are weaknesses because prices of imported raw materials tend to be higher than domestic prices. This is increasingly a burden to the cost of production especially when the rupiah was depreciated to the dollar currency

Recommendations. As all variables have an impact to the inefficiency matter. Some implication should be done. In the context of age variable that affect to inefficiency, government should increase the numbers of training to be followed by human resource. It is for making firms increased in the learning by doing process. Capital intensity should be improved by applying a new technology and in turns will make a better efficiency. Development of the middle and large industry should be balance, It is because of the technical efficiency between middle and large is no quite different.

Firms with non-export orientation should be managed as good as possible by applying a combined technology to increase efficiency and productivity. Firms with domestic capital ownership

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

should learn best practice from the foreign capital ownership, especially after 2010 where the efficiency between this two ownership status. Managers should create a program for increasing the use of a domestic raw material by inviting domestic farmers to engage as the suppliers for firms.

The government should encourage the growth of IFCPI, especially for middle-sized industries, which so far have not received special attention due to large-sized industries priority. The government's desire to accelerate economic growth with export policies and should improve regulations for the benefits of middle-sized industry in order to gain competitiveness, the same as large-sized industry. Government should create a strategy to a technological improvements that needed by the IFCPI to be more productive and efficient.

REFERENCES

Aigner, D. J., Lovell, C. A. K., & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production model. *Journal of Econometrics*, 6(1), 21–37

Ariyanto, Budi (2015). Analisis penggantian komponen mesin tube splicing dan mesin tube curing dengan distribusi weibull dan perhitungan efisiensi biaya di PT Gajah Tunggal Tbk, *MIX:Jurnal Ilmiah Manajemen*, V(1): 70-89

Battese GE, Coelli TJ. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. *Journal of Econometric*, 38(1988): 387-399.

Coelli, T., Prasada Rao, D. & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Massachusetts, USA: Kluwer Academic Publishers

Endri (2010). Pengukuran Kinerja Efisiensi Perbankan Syariah: Analisis Empiris 15 Bank Syariah di Indonesia 2005-2007, *Jurnal Ekonomi dan Pembangunan Indonesia*, X (2): 175-191

Endri. (2018). Impact of Intellectual Capital and Efficiency to the Profitability of Islamic Banking, *International Journal of Science and Research (IJSR)*, 7(7): 230-237

Gong, Binlei (2018). Agricultural reforms and production in China: Changes in provincial production function and productivity in 1978–2015. *Journal of Development Economics* 132 (2018) 18–31

Kim, S. (2003). Identifying and Estimating Sources of technical Inefficiency in Korean Manufacturing Industry. *Contemporary Economic Policy*. 21: 132-144.

Kumbhakar, S.C., (1990). Production frontier, panel data, and time- varying technical efficiency. *Journal of Econometrics*. 46, pp.201-212.

Lundvall and Battese (2000). Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms. *Journal of Development Studies*. 36: 146-163.

Margono, H. and Sharma, S.C. (2006). Efficiency and productivity analyses of Indonesian manufacturing industries. *Journal of Asian Economics*. 17 (2006) 979–995

Mazumdar, Mainak., Rajeev, Meenakshi., Ray, Subhash C. (2009). Output and Input Efficiency of Manufacturing Firms in India: A Case of the Indian Pharmaceutical Sector.The Institue for Social and Economic Change, Bangalore. *Working Paper* 219.

Minister of Industry (2016). In a limited meeting on the topic of policy to increase the utilization of Jakarta's Marine and Fisheries resources potential on 15 June 2016

Meeusen, W. and J. van den Broeck (1977). Efficiency estimation from Cobb-Douglas production functions with composed error, *International Economic Review*. 18(2), pp. 435-444.

Coto-Millán , Pablo, Fuente , Marta de la, and Fernández, Xosé Luís (2018). Determinants of the European electricity companies' efficiency: 2005–2014. *Energy Strategy Reviews*.21 (2018) 149-156.

Pitt, M.M. and Lee, Lung-Fei. (1981). The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry. *Journal of Development Economics*. 9: 43-64.

ISSN : 2088-1231
E-ISSN: 2460-5328
DOI: dx.doi.org/10.22441/mix.2019.v9i1.004

Sparta. (2016). Risiko Kredit dan Efisiensi Perbankan di Indonesia. *MIX: Jurnal Ilmiah Manajemen*. VI (1):28-44,

Sukandar, Beny Mulyana, Achsani , Noer Azam, Sembel, Roy, and Sartono, Bagus (2018). Efisiensi perusahaan konstruksi di Indonesia. *MIX: Jurnal Ilmiah Manajemen*. 8(3): 628-639

Suharyadi dan Sumarto, Agus Herta (2017). Analisis efisiensi industri perbankan indonesia dengan menggunakan metode parametrik: Distribution Free Approach. *MIX: Jurnal Ilmiah Manajemen*, VII(1): 80-96

Walujadi, Dedi (2004). Age, Export orientation and technical efficiemcy: evidence form garment firm in DKI Jakarta, *Jurnal Makara Sosial Humaniora*. Jakarta.

Yapa, M.W.Y.B. and Neil, D.K. (2010). An empirical analysis of Sri Lanka's Manufacturing Productivity slow-down. *Journal of Asian Economics*. 21 (2010) 391–403

ISSN : 2088-1231
E-ISSN: 2460-5328
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