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CONVERGENCE OF EFFICIENCY IN MANUFACTURING INDUSTRY IN INDONESIA: STOCHASTIC FRONTIER ANALYSIS APPROACH

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ABSTRACT

Background

The optimal and progressive level of efficiency will be a reflection of the competitiveness of the manufacturing industry in Indonesia because this sector is related with economic growth.

Aim

This study aims to examine the convergence of efficiency in the manufacturing industry in Indonesia.

Method

The Stochastic Frontier Analysis (SFA) approach is used to test 24 subsectors of large and medium scale manufacturing industries for 6 years. Data obtained through the Indonesian Central Bureau of Statistics were analyzed using the translog and Cobb Doglas approach.

Result

Labor, capital values and output have fluctuated for 6 years related to the global crisis and goverment policy. Based on the estimation results, the production function in 20 sub-sectors are in accordance with the Translog approach, while the other 4 sub-sectors are in accordance with the Cobb Douglas approach. All manufacturing sub-sectors in Indonesia experience divergent conditions. The decrease in efficiency that occurred in all sub-sectors of the manufacturing industry was due to inter-subsidies because the company's operations were disrupted.

Conclusion
Inefficiencies in the manufacturing industry need to be overcome by increasing industrial operational support.

INTRODUCTION

The manufacturing industry is currently the largest sector contributing to the economy in Indonesia. The manufacturing industry had a contribution above 20 percent or an average of 25.66 percent in 2005 to 2014. The percentage decreased in 2014, but its contribution remained the largest compared to other economic sectors (Statistics Indonesia, 2015). The high contribution has implications for the central role of the manufacturing industry in Indonesia (Kurniati, Y., & Yanfitri, 2010). The government has increased the growth of the manufacturing industry in Indonesia through revitalization and restructuring policies in the national long-term development plan (Republic of Indonesia, 2007).

The large contribution of the manufacturing industry toward gross domestic product and government support apparently still not followed by the level of manufacturing industry production in Indonesia. Large and medium industrial sectors have experienced a significant decline in recent years, especially after the 2008 global crisis (Statistics Indonesia, 2015). Fluctuating circumstances occur in this industry. The decline occurred in 2001 to 2005 and occurred again in 2007 to 2011 as a result of the global crisis (Ministry of Industry, 2014). A decline in the value of the output of the manufacturing industry as an indicator of economic performance will affect Indonesia's competitiveness. Indonesia's competitiveness through the Global Competitiveness Index is in the 37th position in the world after in the 34th period (World Economic Forum, 2016). The National Development Planning Agency (Bappenas) said that one of the factors that caused the decline was the inefficiency of the business in rationalizing companies. Such inefficiencies for example occur in the use of energy during the production process. If Indonesia needs 650 KwH to produce steel products, Japan only needs 350 KwH to produce the same amount (Aditiasari, 2014). This condition shows the inefficiency of the manufacturing industry in Indonesia.

Various considerations related to the performance of the manufacturing industry can determine the key indicators that most influence the performance of the industry (Lindberg, C. F., Tan, S., Yan, J., & Starfelt, 2015). The concept of efficiency dynamically stated that the main improvement in the manufacturing industry sector in Indonesia is related to economic technical criteria, two of which relate to efficiency and productivity levels (E. P. Lestari, 2008). One of the parameters that dynamically represent efficiency is efficiency convergence. Assessment is intended to determine the tendency of the each cross section efficiency movement towards or away from certain limits (frontier). The concept of efficiency convergence through panel efficiency testing will produce certain efficiency score trends so that it can be described the efficiency movements of a particular country or entity (Battese, G. E., & Coelli, 1995). Calculation of efficiency convergence is done simultaneously with the level of convergence speed (percentage change of convergence). Efficiency convergence testing is done to determine the

movement of production efficiency that occurs (Kumbhakar, S. C., & Wang, 2005). Inefficient conditions (inefficiencies) can occur due to factors such as insufficient financial institutions, improper supervision of interventions, and others. Hence, basically inefficiencies in large and medium industries in Indonesia will have implications on various dimensions in accordance with modern development models that are not only oriented towards high growth in the aggregate.

Convergence of efficiency is related to increasing productivity of an economic entity (Lei, 2013). This link can be seen from the productivity decomposition which consists of technical efficiency (technical efficiency), scale efficiency, and technical change (Kumbhakar, S. C., & Wang, 2005). Testing the convergence of efficiency will be taken into consideration in the level of production that will be produced to approach its frontier or from its full output capacity. Then, if productivity increases due to converging efficiency, the growth of inputs and changes in productivity will have an impact on increasing economic growth.

This study tried to test the convergence efficiency condition of manufacturing industry in the large and medium scale based on 5 digits of Clarification Baku Lapangan Usaha (KBLI) in Indonesia, the determination of production function as well as determinants parametric that was based on the resulted output of particular efficiency. By using this parameter, causality between one and another determinant can be explained quantitatively. However, in the role of policy development, this parameter can be the main policy that is used to build an industry sector, especially in the large and medium scale in Indonesia. Thus, this study aimed to study about what the best production function that can be used to subsector in the manufacturing industry in Indonesia as well as efficiency convergence in the manufacturing industry subsector in the large and medium scale in Indonesia.

LITERATURE REVIEW

Several studies have produced various conclusions related to the Stochastic Frontier analysis method and Data Envelopment Analysis. Study on rice farmers in India with the Stochastic Frontier analysis method by using the convergence parameter $\delta 1$ showed that there was a convergence of efficiency in rice farmers India in the years of testing (1975-1976 and 1984-1985) (Battese, G. E., & Coelli, 1995). By using similar methods and parameters, other studies stated that the specification of aggregate production functions through inefficiency considerations rejected Cobb Douglas functions. However, this study accepted the Translog function in its calculations (Kneller, R., & Stevens, 2003). According to the same method namely Stochastic Frontier, but different parameters, $\delta 1$ and γ showed that the results of the neglect of heterogeneity in the countries tested showed the same results. This happened if heterogeneity was not ignored, for instance, the countries tested have inefficient divergences. The inefficiency divergence was indicated by a low technological catch up rate parameter which means that the entity experiences a technological regress (Kumbhakar, S. C., & Wang, 2005). Study with parameters β and σ and the Stochastic Frontier method showed that financial integration occurred in banks of the EU through the significant

results on the convergence inefficiency trend (Weill, 2009). Study that was used Envelopment Analysis data with parameters β and σ showed sigma convergence occurred weakly in the telecommunications industry in Africa, whereas beta convergence did not occur at all (Moshi, 2013).

Hypothesis Development

Hypothesis in this study was production function that was compatible was Translog production function and efficiency manufacture industry output in Indonesia was running into convergence. Nol hypothesis was for alternative production function namely Codd Douglas, however alternative hypothesis was the right production function namely Translog. Model that was used was Translog model by using ration variable of capital value an initial capital in the beginning period of its efficiency error value. Translog production function can be seen as follows:

Ln (Y)it = βi + β1 (Ln(K)it) + β2 (Ln(L)it) + β3 ((Ln (Kit))2 + β4 ((Ln(Lit))2 + β5 (Ln(K)it(L)it)) + β6t + vit - uit .....(1)

$uit = \delta 0 + \delta 1(t)$.....(2)

$uit = \delta 0 + \delta 1(\ln(Kit) - \ln(Lit))$.....(3)

Functionally, the production functions of Cobb Douglas in this study as follows:

$Ln\ (Y)t = \beta i + \beta 1(Ln\ (K)it) + \beta 2(Ln\ (L)it\ ) + \beta 6(t) + vit - uit$.....(4)

The explanation of these functions was included *Y* as medium and large industry output. *K* was as capital, *L* was as unit, *vit* was as model error in the i-th observation of t-year, *uit* was as and efficiency error (inefficiency) in the observation I the t-year, $\delta 1$ as a convergence justification, *Kit* was as the initial capital value of the period, *Li* was as the number of labor in the beginning period and, Ln was as natural Logarithm.

METHOD

This study used quantitative method by using secondary data. Data used in this study is taken from annually survey of manufacturing industry in the large scale (> 99 labors) and medium scale (20-99 labors) which is conducted by Statistic Centre on 2007-2013. The number of observations in this study was 123,711 or 17,573 companies in each year. The approach used is the Stochastic Frontier Analysis (SFA) through the study of input and output variables studied to determine the level of efficiency. The output variable used is the output of a large-scale and medium-scale 5-digit manufacturing industry KBLI (Indonesian Business Field Standard Classification) at the firm level. The input variables used were fixed capital (K) and labor (L) from the large and medium-sized manufacturing industry KBLI (Indonesian Business Field Standard Classification). However, in the analysis process, this study classified the manufacturing subsector based on 2 digits.

The balance data panel was used to estimate the production function of stochastic with the inefficiency effects. The change of ISIC code in the Baku Lapangan Usaha Indonesia (KBLI) group caused the need of adjusting the company that was analyzed. This should be done to ensure the company that was analyzed was the same company during 7 years. This happened because on 2007-2009, the guideline of Kelompok Baku Lapangan Usaha Indonesia (KBLI) which was used was KBLI guideline on 2009. The analysis technique used the determination of production function. The production function which would be chose was Translog production function and Cobb Douglas production function which would be tested by using Translog production function. Model that was used is Battese Coelli (BC) model and Kumbhakar Wang (KW).

The determination of production function and the calculation of technical efficiency were used by using Frontier 4.1 application through the likelihood ratio (LR) test approach. The technical efficiency needed to be calculated to know its convergence trend. The value of technical efficiency was calculated from the value ration actual output and potential output with the note that the value was nder 1, the company was running into inefficient condition. This study used ui parameter as efficiency convergence parameter. Efficiency convergence can be known by looking at time convergence as well as the deviation between the value of initial capital and number of initial labor namely $\delta 1$. The condition of efficiency convergence was happened if $\delta 1$ was negative. If the efficiency was not convergence, so $\delta 1$ was positive.

RESULT

The value of manufacturing industry output has fluctuated in total output from year to year. Overall the biggest increase was able to reach above 100%. The increase in aggregate in 2007 to 2013 was 29.15 percent. In 2008, the decline in output occurred in more than 50 percent (13 subsectors) of the manufacturing subsector, while the remaining 11 subsectors experienced an increase in output. The number of subsectors that experienced a decrease in output decreased to 12 subsectors, while 12 others experienced an increase in 2009. In 2010, the number of subsectors that experienced an increase and a decrease in output did not change. However, there was a change in the subsector. The number of subsectors that experienced a decline in output again declined, while the subsectors that experienced an increase increased in 2011. There are 9 subsectors that experienced a decline. There are 15 subsectors that have increased output. The number of subsectors that experienced an increase in output increased again, while those that experienced a decrease decreased in 2012. There are 16 subsectors that have increased output. In 2013, the number of subsectors which experienced a decrease increased compared to 2012, while those of the subsector that experienced an increase decreased. There were ten subsectors that experienced a decline in output. One subsector that experienced an increase in output in 2008 to 2013 was the electrical equipment industry.

The output value of large and medium scale manufacturing industries in 2007-2013 has an upward trend. In 2008, the increase was 7.29 percent. In 2009, the increase was 1.85 percent. In 2010, the decline was 0.81 percent. Another increase occurred by 10 percent in 2011. The increase was 8.19 percent in 2012. In 2013, the increase was 6.41 percent. The increase in output in 2007 to 2013 was due to various coaching in increasing the production of manufacturing companies.

The capital value of large and medium manufacturing industries which in 2007 amounted to Rp. 14,464 trillion, increased in 2013 to Rp. 149,956 trillion. The value of capital in 2013 was 10 times that of 2007 or 90.35 percent. The capital value of the manufacturing industry has fluctuated. The total capital value in 2008 and 2009 was increased by 22.47 percent and 2.18 percent. However, in 2010 it decreased by 26.8 percent to Rp 21.622 billion. The increase occurred again in 2011, 2012 and 2013, namely 10.03 percent, 74.74 percent and 36.87 percent.

The biggest decline in capital value could reach more than 100%. There were 11 subsectors that experienced a decline in capital values, while the remaining 13 subsectors experienced an increase in 2008. In 2009 the number of subsectors that experienced a decline in the value of capital increased to 14 subsectors. There were 11 subsectors experienced a decline, while the remaining 13 subsectors experienced an increase in 2010. In 2011 the number of subsectors that experienced a decline in the value of capital increased to 12 subsectors, while the remaining 12 subsectors experienced an increase in the value of capital. All capital values in 24 subsectors increased in 2012. This increase was large, especially in 2012 where efforts to restructure machinery have been pursued by the government. In 2013 there were three subsectors that experienced a decline in the value of capital, while the remaining 21 subsectors experienced an increase.

The capital value of the manufacturing industry in 2007-2013, almost all subsectors had experienced a decline in the value of capital. The capital value of the manufacturing industry in Indonesia tends to fluctuate, especially during the period of the global crisis in 2008. However, these conditions have begun to stabilize in 2012. Aggregate capital values generally have an upward trend, even though in 2010 they fell.

The value of large and medium scale industrial capital in 2007 to 2013 tends to fluctuate. In 2008 there was an increase in the value of capital by 22.47 percent. In 2009 there was an increase of 2.18 percent. In 2010 there was a decrease of 26.8 percent. The increase of 10.03 percent was happened in 2011. Then, a big increase occurred in 2012 which amounted to 74.74 percent, and 36.87 percent in 2013.

The number of workers in 2007 was 3,802,570 people, increasing to 4,114,665 people in 2013 (7.58 percent or 1.08 times). The number of workers in the manufacturing industry tends to fluctuate. In 2008 the increase occurred 0.987 percent. However, in 2009 there was a decrease in the number of workers by 1.076 percent. Then in 2010, 2011, 2012 there were increases in succession of

2.652 percent, 2.338 percent and 4.33 percent. The decline again occurred in 2013 which amounted to 1.574 percent, until the number of manufacturing industry workers in 2013 was as many as 4,114,665 people.

There were 11 subsectors in 2008 that experienced an increase in the number of workers, while the rest experienced a decrease in the number. The number of subsectors in 2009 which experienced an increase in the number of workers became 12 subsectors, while 12 other subsectors experienced a decline. In 2010 the number of subsectors has decreased to 5 subsectors, while the remaining 19 subsectors have increased. There were four sub-sectors of the manufacturing industry that experienced a decrease in the number of workers, while the remaining 20 subsectors experienced an increase in the number of workers in 2011. The number of subsectors in 2012 that experienced an increase in the number of workers became 19 subsectors, while the remaining five subsectors experienced a decrease in the number of workers. In 2013 there were 13 manufacturing industry subsectors that experienced a decrease in the number of workers, while the remaining 11 subsectors experienced an increase. Almost all subsectors have experienced a decline in the number of workers. The number of workers in the manufacturing industry in Indonesia tends to fluctuate. Major increases occurred in a number of sub-sectors, particularly the subsectors that were realized investment plans and resulted in employment.

The number of labor in the manufacturing industry in the large and medium scale tend to has increasing trend, but sometimes it runs to decrease. There was increasing in 2008 about 0,98 percent. In 2008, there was increasing number of labor because of the crisis global happened in the last year and its effect was affected in the beginning of 2009. There was decreased on 2007 about 1,07 percent. However, in 2010, 2011, 2012, there were consecutive increases of 2.65 percent, 2.38 percent and 4.33 percent. However, in 2013 there was a decrease of 1.57 percent. The conditions for increasing and decreasing output, capital and labor in 24 subsectors in 2007-2013 are summarized in the table below.

Table 1. Output Matrix, Capital and Manufacturing Industry Employment

Code matrix/year	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Industry output																								
2007	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	↑	↓	↑	↓	↓	↑	↓		↓	↓	↑	↓	↑	↑	↓	↓	↓	↑	↑	↓	↓	↑	↓	↓	↓
2009	↑	↑	↓	↑	↑	↓	↓		↑	↑	↓	↓	↑	↓	↓	↓	↑	↑	↑	↑	↑	↑	↓	↓	↓
2010	↓	↑	↓	↓	↑	↑	↑		↑	↓	↓	↓	↓	↑	↓	↑	↑	↓	↑	↑	↑	↓	↓	↑	↑
2011	↑	↓	↓	↑	↓	↑	↑		↑	↑	↓	↑	↓	↑	↑	↓	↑	↑	↑	↑	↑	↓	↑	↓	↓
2012	↑	↑	↑	↓	↑	↑	↑		↑	↓	↑	↑	↓	↓	↓	↑	↑	↓	↑	↑	↓	↑	↓	↓	↑
2013	↑	↑	↑	↑	↑	↓	↓		↓	↓	↑	↑	↑	↓	↑	↑	↓	↑	↑	↑	↓	↓	↓	↑	↑
Industry Capital Value																								
2007	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	↑	↓	↓	↓	↓	↑	↑		↑	↑	↑	↓	↑	↑	↓	↑	↑	↑	↓	↑	↑	↓	↑	↓	↓

2009	↑	↑	↓	↑	↑	↓	↓	↓	↑	↓	↓	↓	↓	↓	↓	↑	↑	↓	↑	↑	↓	↓	↓
2010	↓	↓	↓	↑	↓	↑	↓	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↓	↑	↑	↓	↑	↑
2011	↑	↓	↑	↑	↑	↑	↑	↑	↓	↓	↑	↓	↓	↑	↓	↑	↑	↑	↓	↓	↑	↓	↓
2012	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑
2013	↑	↑	↑	↑	↑	↑	↑	↓	↓	↓	↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑
Number of Labor																							
2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	↓	↓	↑	↓	↓	↑	↑	↓	↑	↓	↑	↑	↑	↓	↑	↑	↓	↑	↑	↓	↑	↓	↑	↑
2009	↓	↑	↓	↓	↑	↑	↓	↓	↓	↑	↓	↑	↓	↓	↓	↓	↑	↑	↑	↑	↑	↓	↑	↓
2010	↑	↑	↑	↑	↑	↓	↑	↑	↓	↑	↑	↑	↑	↓	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑
2011	↑	↓	↓	↓	↑	↑	↓	↑	↓	↓	↑	↑	↑	↑	↑	↓	↑	↑	↓	↑	↑	↑	↓	↓
2012	↑	↑	↑	↑	↑	↑	↑	↓	↑	↑	↑	↓	↓	↑	↓	↑	↓	↑	↑	↑	↑	↑	↑	↑
2013	↓	↑	↑	↓	↓	↓	↑	↑	↑	↑	↑	↓	↑	↓	↑	↑	↑	↓	↑	↑	↓	↓	↓	↑

Note: ↑ : Increased, ↓: Decrease

The estimated result of production function determination showed that almost subsector from 24 manufacturing subsectors in this study showed Cobb Douglas was rejected whether in the BC model or KW model. Printing Industry, Rubber Industry, Rubber, and plastic goods, reproduction of recording media, as well as Metal, Non-Machinery and Equipment Industry showed that Translog is rejected. The selection of production functions is presented in table 2.

Table2. The Determination of Production Function

Subsector	**BC Model**			**KW Model**		
	λ Calculation	$\chi 2$ 1%	Conclusion	λ Calculation	$\chi 2$ 1%	Conclusion
Food Industry	732.646	113,449	*	9933,98	113,449	*
Beverage Industry	117.928	113,449	*	553,496	113,449	*
Processing industry Tobacco	1.868.308	113,449	*	2271,76	113,449	*
Textile Industry	159.004	113,449	*	6964,93	113,449	*
Apparel Industry	156.41	113,449	*	7530,84	113,449	*
Leather Industry, Goods from Leather and Footwear	16.918	113,449	*	3230,77	113,449	*
Timber	2.995.37	113,44	*	3175,5	113,44	*

Industry, Goods from Wood, and Cork	8	9			9	
Paper and Goods Industry from paper	986.532	113,449	*	1522,51	113,449	*
Printing Industry, Reproduction of Record Media	-422.156	113,449	**	1224,66	113,449	*
Industrial Products from Coal and Refinery Crude oil	5.090.786	113,449	*	887,289	113,449	*
Chemical Industry and Articles of Chemicals	121.198	113,449	*	1029,66	113,449	*
Indutri Pharmacy, Products Chemical Medicine, and Medicines Traditional	91.693	113,449	*	694,623	113,449	*
Rubber Industry, Goods from Rubber and Plastic	-283.38	113,449	**	2643,78	113,449	*
Galian Goods Industry	246.012	113,449	*	15565,2	113,449	*

Not Metal						
Basic Metal Industry	699.658	113,449	*	392,567	113,449	*
Metal Products Industry, Not a machine, and The equipment	-12.99	113,449	**	1806,81	113,449	*
Computer Industry, Goods Electronics and Optics	351.698	113,449	*	674,508	113,449	*
Electrical Equipment Industry	687.218	113,449	*	744,951	113,449	*
Machine Industry	3.497.068	113,449	*	777,722	113,449	*
Vehicle Industry Motorized, Trailer and Semi Trailer	1.150.022	113,449	*	657,544	113,449	*
Transportation Equipment Industry Others	1.584.376	113,449	*	435,671	113,449	*
Furniture Industry	-314.878	113,449	*	5005,68	113,449	*
Other Processing Industries	-3.038.548	113,449	*	1237,87	113,449	*
Repair Service and Engine Installation and	1.278.286	113.449	*	574,835	113.449	*

Equipment						

Note: *Cobb Douglas was rejected, **Translog was rejected

Estimation of the appropriate production function used the Likelihood Ratio (LR) test. The dominant production function used was the Translog production function. The Cobb Douglas production function was based on the BC model selected in the sub-sector 1) Printing, Reproduction of Recording Media, 2) Rubber Industry, Rubber and Plastic Products, 3) Metal Industry, Non-Machinery, and Equipment Industries, and 4) Other Processing Industries. In addition to the four subsectors, all manufacturing sub-sectors used the Translog production function. The Cobb Douglas production function was rejected on the KW model. These results were consistent with research by Kumbhakar and Wang (2005).

The efficiency of the 24 sub-sectors of the manufacturing industry in Indonesia was experiencing a convergent condition. This was indicated by the coefficient value of δ1 positive which means that there was no convergence of efficiency in the manufacturing industry in Indonesia. The existence of a positive value of the coefficient δ1 which was the coefficient of the time variable means that if time increases the inefficiency value will increase, or in other words the level of efficiency will decrease. Thus, this condition is said to be a condition of efficiency that is not converging. 12 manufacturing industry subsectors experienced convergence and the remaining 12 subsectors did not converge. However, the significance assumption that must be fulfilled did not occur in the estimation results using the KW model, except in the Machine and Equipment Industry subsector which was significant at the 10 percent level and showed convergent conditions even though the level of convergence was small. The condition of not fulfilling the significance assumption means that the difference between the value of initial period capital and the number of workers in the initial period does not statistically affect the level of inefficiency of the manufacturing industry in Indonesia (except in the machinery and equipment industry). Hence, the KW model cannot be used to justify the convergence of the efficiency of the manufacturing industry in Indonesia.

Efficiency convergence can be known through the time variable coefficient parameter yakni1 (delta). The parameter is derived from the Z value of the time trend variable vector. The variable is a composition of inefficiency values (uit) from the Translog and Cobb Douglas models. Estimation results that were used the Translog production function in 20 manufacturing subsectors and estimation using the Cobb Douglas production function in 4 manufacturing subsectors. The results of the estimated convergence of efficiency based on the BC and KW models are presented in table 3.

Table3. Estimated Result of Efficiency Convergence based on BC and KW Model

	BC Model			**KW Model**			
Subsecto	δ0	δ1	Conclusion	δ0	δ1	γ	Concl

r/							usion
Translog Production Function							
Food Industry	-3.752***	0.733***	Not Convergence	-0,000	-0,000	0,050	Convergence
Beverage Industry	-0.225***	0.067***	Not Convergence	-0,000	0,000	0,340	Not Convergence
Processing industry Tobacco	-3.343***	0.792***	Not Convergence	0,000	0,000	0,460	Not Convergence
Textile Industry	-2.549	0.615***	Not Convergence	-0,000	0,000	0,510	Not Convergence
Apparel Industry	-1.529***	0.413***	Not Convergence	-0,000	0,000	0,720	Not Convergence
Leather Industry, Goods from Leather and Footwear	-1.358	0.307***	Not Convergence	-0,000	0,000	0,050	Not Convergence
Timber Industry, Goods from Wood, and Cork	-2.256***	0.465***	Not Convergence	-0,000	0,000	0,560	Not Convergence
Paper and Goods Industry from paper	-4.166***	0.820***	Not Convergence	-0,000	0,000	0,620	Not Convergence
Printing Industry, Reproduction of Record Media				-0,000	0,000	0,050	Not Convergence
Industrial Products from Coal and Refinery Crude oil	-4.428	0.833**	Not Convergence	-0,000	-0,000	0,280	Convergence

Chemical Industry and Articles of Chemicals	-4.828***	0.912***	Not Convergence	-0,000	-0,000	0,670	Convergence
Indutri Pharmacy, Products Chemical Medicine, and Medicines Traditional	-1.347***	0.322***	Not Convergence	-0,000	-0,000	0,050	Convergence
Rubber Industry, Goods from Rubber and Plastic				-0,000	-0,000	0,050	Convergence
Galian Goods Industry Not Metal	-0.351***	0.091***	Not Convergence	-0,000	-0,000	0,050	Convergence
Basic Metal Industry	-6.935***	1.151***	Not Convergence	0,000	-0,000	0,650	Convergence
Metal Products Industry, Not a machine, and The equipment				-0,000	-0,000	0,050	Convergence
Computer Industry, Goods Electronics and Optics	-3.281***	0.621***	Not Convergence	-0,000	-0,000	0,380	Convergence
Electrical				-0,000	0,000	0,600	Not

Equipment Industry							Convergence
Machine Industry	-4.815***	0.946***	Not Convergence	0,303***	-0,000*	0,000	Convergence
Vehicle Industry Motorized, Trailer and Semi Trailer	-6.178***	1.092***	Not Convergence	-0,000	0,000	0,460	Not Convergence
Transportation Equipment Industry Others	-4.877***	0.955***	Not Convergence	-0,000	-0,000	0,230	Convergence
Furniture Industry	-1.240***	0.256***	Not Convergence	-0,000	0,000	0,430	Not Convergence
Other Processing Industries				-0,000	0,000	0,050	Not Convergence
Repair Service and Engine Installation and Equipment	-2.421***	0.589***	Not Convergence	-0,000	-0,000	0,050	Convergence
Cobb Douglas Production Function							
Printing Industry, Reproduction of Recording Media	-2.569***	0.629***	Not Convergence				
Rubber Industry, Rubber Products and Plastics	-3.824***	0.766***	Not Convergence				
Manufacture of metal	-0.282***	0.083***	Not Convergence				

goods, not machinery, and equipment							
Industri Pengolahan Lainnya	-2.275***	0.512***	Not Convergence				

Note: *** = Significant in the error level 1%, ** = Significant in the error level 5%, *= Significant in the error level 10%

DISCUSSION

Based on the estimation results, the appropriate production function for the 20 subsectors was the Translog production function, while the other 4 subsectors used the Cobb Douglas production function. Based on the model from Battese and Coelli (BC), 24 manufacturing sub-sectors in Indonesia are experiencing divergent conditions. The reason was that the crisis period that occurred in 2008 made the research period capture conditions before the crisis, during the crisis, and after the crisis, so the convergence trend tends to decrease. Even the trend of increasing inefficiency continues during post-crisis conditions (2009 to 2013). The performance of the manufacturing industry is described as not converging in its efficiency due to the global crisis. These results were different from the Kumbhakar and Wang (KW) models which show 11 subsectors that were in convergent condition. However, the significance assumption that was not fulfilled makes the KW model cannot be used as a parameter to be analyzed. This result means that the capital and labor ratio at the beginning of the period (in 2007) as a specification of the KW model did not affect technical inefficiency. The existence of the global crisis in 2008 would make capital and labor conditions different from 2007, so the 2007 ratio cannot affect the level of technical inefficiency in the manufacturing industry in Indonesia. If the machinery subsector has an influence, it can be interpreted that there is an influence in 2007 against 2008. Because, the machinery industry will tend to use its equipment in the long run, so that the capital and labor ratio will have an effect.

The non-convergent efficiency of the manufacturing industry in 2007 to 2013 was interpreted as an efficiency trend away from the frontier. This condition means that the level of efficiency in the previous year was lower than the current year. The decrease occurred until the end of the testing period in 2013. The efficiency trend away from the frontier (divergent) can be caused by various factors. In connection with the results of testing in the period 2007 to 2013, the condition of the decline was caused by the period of the global crisis in 2008 which caused the level of efficiency of the manufacturing industry to decline (efficiency away from the frontier). The decline was caused by the dominance of imported manufacturing industry inputs. Moreover, the recovery process after the global crisis that impacted the manufacturing industry in Indonesia requires a long time. Therefore, there is a decrease in the trend of

the level of efficiency throughout the testing period (Ruchba, S. M., & Permana, 2015).

This situation can be caused by problems with the input that affect the output. Changing labor conditions, unstable capital values cause fluctuating output. This situation is influenced by the policies of business owners and the government. This decline occurred due to the global crisis which resulted in termination of employment (layoffs) of workers in the manufacturing industry. The large capital increase was the impact of the Ministry of Industry's efforts in restructuring industrial machinery such as textiles and leather in 2009 to 2012. In addition, guidance from the government in certain years affected the output of the manufacturing industry.

The decreasing level of efficiency in the manufacturing industry indicates that the industrialization policy that was initiated has not been successful in increasing efficiency (E. P. Lestari, 2008). This sign relates to the policy tools manifested in the legal instruments concerning the priorities of the manufacturing industry as a driving force for the economy. In addition, the declaration of the manufacturing industry in the national medium-term development plan as a priority sector also seems to have not succeeded in improving the performance of Indonesia's manufacturing industry. Hence, an accelerated effort is needed so that the industrialization policy, which is initiated by the law or the master plan, can run optimally. Efficiency divergences by subsector are caused by a number of more specific factors. In the tobacco processing sub-sector in Indonesia which was also not experiencing a convergent condition, the decrease in efficiency was caused by increased expenditure on inputs (Puspitasari, 2011). The expenditure of these inputs comes from the policy of launching new variant products in the tobacco processing industry. Though there are limitations to the production machinery owned by the tobacco processing industry. Thus, there are ongoing inefficiencies in 2007 to 2013.

In the textile industry, the condition of efficiency which is not converging is caused by the empirical condition of industrial production factors (Hermawan, 2015). The condition of machines in the textile industry is almost 75 percent nearing 20 years. The impact is increased inefficiency and uncompetitive product quality. In addition, dependence on imported raw materials, which account for 27.2 percent of total inputs, makes the textile sector vulnerable to fluctuations in economic value. Moreover, in the testing period there is a period of global crisis. In addition, the existence of a quota system policy for imports of textiles and textile products in 2005, especially in the countries of the textile industry and textile products, has an impact on products that must be confronted directly with textile producing countries and giant textile products such as China, India, Bangladesh, and Pakistan. So the level of sales of the domestic textile industry declined. The availability of raw materials is also the cause of a decrease in the technical efficiency of the manufacturing industry sub-sector in Indonesia (Soekro, S. R., & Arifin, 2008). One example is the wood industry and the paper industry which has wood raw materials from certain trees. Timber raw material that cannot regenerate quickly results in massive logging. This condition caused the continuity of raw materials for

the wood industry and the domestic paper industry to decrease (P. S. Lestari, 2015). So this makes a tradeoff between efforts to increase production and maintain the existence of forests in Indonesia. The impact is the wood industry and manufacturing industry will depend on wood imports which will fluctuate in the event of a global crisis.

The decrease in efficiency that occurred in all sub-sectors of the manufacturing industry is due to inter-subsector relations. This linkage occurs in almost all manufacturing sub-sectors, for example in the textile industry which has links to the apparel industry, the leather industry, and the wood industry. The dependence of these three industries with the textile industry can be in the form of dyes used for the production process. If the textile industry's dependence on imported inputs is still large, a global crisis will have an impact on the production of the textile industry. This condition will also have an impact on the three industries that use the output of the textile industry.

Another case was the basic metal industry with the machinery industry, metal goods industry, and printing industry. A decrease in efficiency due to the global crisis in the base metals industry will have an impact on these three industries. Because, the raw materials used by the machinery industry come from the base metal industry. This also happens in the printing industry and the metal industry that uses output from the base metal industry. Therefore, the inter-sub-sector linkages in the aspect of raw material production cannot be avoided even though the sub-grouping has been standardized according to the Indonesian Business Field Standard Classification (KBLI). This will have an impact on the influence of a subsector on the other subsectors.

The strategy for developing the manufacturing industry needs to be done. The development strategy in the manufacturing industry must start from determining the development priorities of the manufacturing industry (E. P. Lestari, 2008). The intended priority is between using a broad-based development strategy (broad base strategy) or a special advantage-based strategy policy owned by the industry with a good level of efficiency. In broad-based development strategies, efficiency disparities between subsectors must be a concern. Therefore, convergent efficiency means that the level of disparity between subsectors decreases. Whereas in the special advantage-based development strategy, the sub-sector that has optimal efficiency must be a development priority. These priorities can be actualized through the provision of incentives so that production can be stable. However, if a special embrace strategy is implemented, the potential for social jealousy will occur. In the subsector that has a high absorption rate but the use of technology is still low it also needs to be a concern. Therefore, the contribution of the subsector will be even greater if the contribution of technology is added.

The policy to make the manufacturing industry have converging efficiency means that the policy seeks to increase the level of efficiency across all entities. This is caused by increased efficiency is a reflection of economic reform (economic reform). The intended economic reform is the improvement of the subsector in the manufacturing industry so that it can improve in terms of the quality and competitive climate. Furthermore, this condition will attract

investors while increasing the competitiveness of the manufacturing industry in Indonesia.

CONCLUSION

The production function of Cobb Douglas is chosen by 4 subsectors, whereas, the production function of Translog is chosen by another 20 subsectors. The result analysis used Stochastic Frontier Analysis which used variable coefficient time as the convergence justification which is found that 24 subsectors of manufacture industry during 2007 until 2013 is not running into efficiency convergence. It can be happened because of some crisis which has an effect in the domestic economy.

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