THE DISPARITY EFFICIENCY IN SUB-SECTORS OF MANUFACTURING INDUSTRY IN INDONESIA

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ABSTRACT

One of the important issues in the manufacturing sector in Indonesia is the disparity in the level of efficiency sub-sectors of the manufacturing industry in Indonesian. The problems caused by inefficiency in the structure of the market, their mastery of the dominant for some particular type of business in their sub-sectors in the manufacturing sector. The aim of this study is to analyze the disparity efficiency of 24 subsectors of manufacturing industry in Indonesia during 2011-2013, using Data Envelopment Analysis. The results show the efficiency level of manufacturing industry in Indonesia during 2011-2013 have not reached the optimum level of efficiency and the disparity of efficiency among subsectors in manufacturing industries. The low value of efficiency in Indonesia's manufacturing industry sub-sector due to the allocation of less than the maximum input in generating output. Sub-sectors which have a low value is a labor-intensive sub-sectors are loaded with the power of the human family and the technology has not been widely used so that the added value is small. Strategic Government policies toward industrial development.

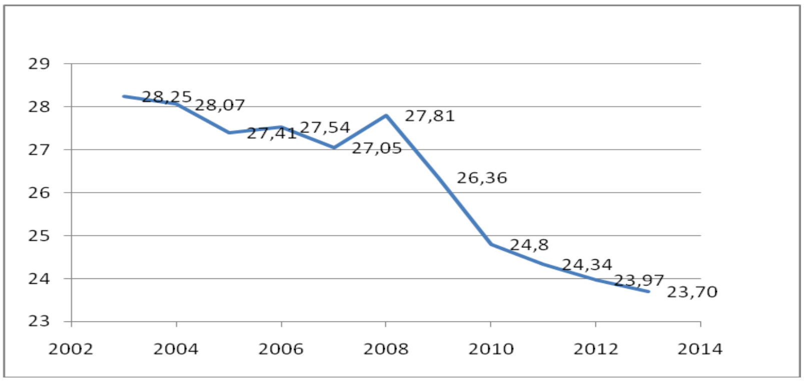
Key words: Efficiency, Manufacturing, Data Envelopment Analysis

Introduction

The world's manufacturing industry experienced a slowdown in growth in 2012. Based on the results of research carried out United Nations Industrial Development Organization (UNIDO), the global manufacturing industry in the third quarter of 2012 only grew by 0.2 percent compared to the previous year. The world's manufacturing industry is experiencing severe challenges due to the recession in the European countries and weakening economic growth in North America, East Asia and the slowdown of economic growth in some developing countries. The global recession will constrain the development impact of the world economic slowdown will be a serious problem because it will have an impact on Indonesia's manufacturing industries that are export oriented.

In Indonesia, the manufacturing industry is one of the leading sectors that drive economic growth. In the period of last 10 years of Indonesian manufacturing industry growth in the range of 2.2 to 6.1%. However, one thing that is troubling is that after a period of economic crisis of 1998 ends, to the years 2003-2013 the manufacturing industry's contribution to Gross Domestic Product (GDP) of Indonesia showed a decline, especially since 2008.

Figure 1. The contribution to GDP Indonesia Manufacturing Industry 2003-2013



Source: Biro Pusat Statistik, 2013

Some of the alarming decline in the manufacturing industry's contribution to GDP of Indonesia in the last decade, even mentioning that the era of de-industrialization has hit Indonesia. Optimism in the building industry in Indonesia should not be stopped. Technology in the development of the manufacturing sector has an important role and are appropriately addressed. The low competitiveness of the manufacturing industry and the emergence of allegations that the inefficiencies that make Indonesia's manufacturing industry is not performing optimally. Based on the results of empirical studies proved that technological contribution to the growth of industrial sector in Indonesia has not been so instrumental in significantly and relatively far behind other countries in the Asia-Pacific region.

The important issues relating to the manufacturing sector in Indonesia, the possibility of disparities levels of efficiency and productivity of each sub-sector of the manufacturing industry in Indonesian. These problems can occur due to the inefficiency in the structure of the market, namely their market share is so large and dominant for a certain type of business in each sub-sector is in the manufacturing sector. In addition, the results of the empirical findings provide a real evidence that the level of technology utilization and productivity in the manufacturing industry in Indonesia, are still relatively low compared to the productivity of capital and labor. Its potential and should be used and measured capacity of the research on the extent to which the efficiency level and changes in the use of technology in the manufacturing industry in Indonesia is important to do in order to see and explain the importance of having a unified planning about development policy in the sector this. The importance of implementing the policy was based on the theoretical consideration that the development policy of the manufacturing industry should be within the framework of policies to prioritize development manufacturing industry is focused on the types of manufacturing industries whose productivity is high and has great competitiveness so as not to get stuck on a policy-based industries wide, but does not have the advantage of being able compared with other manufactured products.

Research Design

Charnes, et.al, (1978) stated that the Data Envelopment Analysis (DEA) is a mathematical program optimization method that measures the technical efficiency of decision-making units (DMU) and comparing it relative to another DMU. DEA was originally developed by Farrell (1957), which measures the efficiency of the technique one input and one output, which later evolved into a multi-input and multi-output, using a framework of values relative efficiency as a ratio of input or single virtual input to output or single virtual output (Giuffrida and Gravelle, 2001, Lewis, et.al, 1989, Post and Spronk, 1999). DEA was originally popularized by Charnes, Cooper and Rhodes (1978) utilizing the method of constant returns to scale (CRS). DEA is an analytical tool used to measure efficiency in various fields, among others for health research, education, transport, manufacture, or banking. The benefits derived from the measurement of the efficiency with DEA (Insukindro et al, 2000), first, as a measure to obtain the relative efficiency that is useful to facilitate comparisons between the same economic unit. Second, measure the variations between the units of economic efficiency to identify the contributing factors, and the third, determine the implications of the policy so as to increase the level of efficiency.

In the case of varying input and output, the efficiency of a DMU calculated by transforming into an input and a single output. This transformation is performed by determining the appropriate weighting. Determination of the weighting is always a problem in the measurement of efficiency. DEA is used to solve the problem by giving freedom to each DMU to determine weights respectively. Construction DEA frontier that is based on a sample of actual data will be more efficient than the DEA is not using frontier. DMU efficiency measured by output divided by the weight ratio of the weight of input (total weighted output / total weighted input). The weights have a positive value and are universal, meaning that every DMU in the sample should be able to use the same set of weights to evaluate the ratio (total weighted / total weighted input ≤ 1). The ratio of 1 (or lack of one) means the DMU efficient (inefficient) to produce the maximum output level of each input. DEA assumes that every DMU using different input combinations to produce different output combinations. So every DMU will choose a set of weights that reflect that diversity. Generally, DMU will assign a high weight to inputs that use little to maximize output and vice versa.

Validation of the model is a very important stage in the model building process wherein the process provides a very important contribution to understanding economic phenomena being studied. The model validation process is intended to present evidence on the use of general theories and techniques of model building. (Muchdie, 1998). To estimate the efficiency of industrial production of the respective types of business then used the model with n decision-making units or referred to the unit of economic activity or decision-making unit (DMU).

Figure 2. The vector of the data sets

DMU	Output (Y) 1,2,........r..........s	Input (X) 1,2,..........j.........m
1	⋮	⋮
2		
⋮		
j	.... y^{rj}	.... X^{ij}
⋮		
n		

where $y^{rj} \geq 0$ and $x^{ij} \geq 0$

The assumption used is *n* DMU has been producing *s* outputs of the *m* input used. DMU j or $x^{ij} \geq 0$ describe the input i that can not be negative and $y^{rj} \geq 0$ describe that all r output unit also can not be negative. Other symbols used in the form which is the input vector xj and yj which is a vector output.data inputs and outputs that have been observed will be used to construct a model of technology references. This model will adopt a concept developed by Farrell (1957), which measures the efficiency of X is the ratio of input to output.

Part of this discussion can begin by defining some notation. Assuming K is the input and the output M is for any company referred to by DMU. To DMU to-i are represented respectively by the vector xi and yi. In case X is input matrix K x N and Y is output matrix M X N, then such representation is a way of formulating the data in the form of a matrix of all N DMU. The purpose of the DEA is to form a non-parametric envelopment frontier to a data from the observation point under frontier. One simple case that can be made an example here is the case of an industry that produces one output using two inputs, whereas it could be illustrated in a graph as the number of meetings or field lines which envelops the distribution of scattering in three-dimensional space.

DEA uses the form of ratios. For each DMU, we get the size ratio of all output to all inputs such as u'yj / v'ki, where u is an M x 1 vector of output weighted (weight output) and v is the vector k x 1 from the input weighted. To select the optimal weights we must specify the mathematical programming problem as follows:

$$\text{Max}_{u,v} \left(\frac{u' y_i}{v' x_j.}\right) \quad (1)$$

$$\text{s.t.} \quad \frac{u' y_i}{v' x_j} \leq 1, \quad j = 1,2,\ldots,N$$

$$u, v \geq 0 \quad (2)$$

In this case, including also find a value for u and v as a measurement of the efficiency of DMU i^{th} maximum with a view to the constraint that all the efficiency measures should be less than or equal to one. One of the problems with the formulation or the formulation of this ratio is that it has a number of solutions is infinite, meaning that if (u *, v *) is the solution then (αu *, αv *) are also other solutions. To avoid this, we can determine the obstacle u'xi = 1 which stipulates that:

$$\text{Max}\ \mu, v(\mu', y_j) \quad (3)$$

$$\text{s.t.}\ v * x_i = 1$$

$$\mu', y - vj \leq 0,\ j = 1,2,\ldots,n$$

$$\mu, v \geq 0 \quad (4)$$

where the notation was changed from u and v into μ and v which indicates the occurrence of transformation. This form is known as multiplier form of linear programming problem. Using the duality model in the linear programming can be derived from the envelope curve (envelopment) that is equivalent to or the same as the problem above, namely:

$$\text{Min}\ \theta, \lambda\theta, \quad (5)$$

$$\text{s.t.} - yi + y\lambda \geq 0,$$

$$\theta xi - x\lambda \geq 0$$

$$\lambda \geq 0 \quad (6)$$

where θ is a constant of scalar and λ constant of vector N x 1. Forms envelopment involves fewer constraints (constraints) rather than the form of the multiplier (K + M <N + 1) and has been used as a general reference to solve the problems faced. Values θ obtained from an efficiency rate for DMU to-i. It meets the value $\theta \leq 1$, where a value of 1 indicates a point on the production possibility frontier (frontier) and hence it is called technically, DMU that efficiency refers to the definition set by Farrell (1957). Noting that the problem should be solved as linear programmes N times for each DMU in the value of θ can then be obtained for each DMU.

CRS model is only suitable if all of the DMU is operating at an optimal scale. Several factors such as imperfect competition, financial constraints and so are thought to cause a DMU is not operating at optimal scale. Banker, Charnes and Cooper (1984) proposed a model CRS expanded by implementing the VRS, on the grounds that not all DMU operating at optimal scale will produce a measurement technical efficiency (TE) mingled or confounded by the measurement results (scale efficiency/SE). With VRS allows the calculation of TE can totally eliminate the effects of this SE.

DEA analysis method as proposed by Charnes, Cooper and Rhodes (1978) applied to the model with inputs that are assumed to be Constant Return to Scale (CRS). In CRS assuming all DMU operating at optimal scale, whereas in real conditions DMU may operate not optimal, it is used for VRS assumptions. Data Envelopment Analysis is widely used to solve problems related to inefficiency. Some studies using DEA, among others, education, insurance, agriculture and industry (see Abbott and Doucouliagos (2003), Kao and Hwang (2008), Lestari (20015) and Zhanh, et.al (2008). Lestari (2007) applied DEA to measure the disparity between the technical efficiency of manufacturing industry subsectors Indonesia in 1990-2002 found that the calculation method of the VRS had a relatively similar result with CRS method in the study period. Measuring the level of efficiency disparity between sub-sectors in the manufacturing industry in Indonesia is done by using indicators such as the value of a coefficient of variation (coefficient of variation / CV) as suggested by Jefferson and Wu (1994). Mathematically, this coefficient is formulated as follows:

$$CV_i = \frac{SD(ME_{ij})}{ME_{ij}} \quad (7)$$

where CV = coefficient of variation, SD = standard deviation of the average efficiency of the overall DMU i in period j, while ME is the level of efficiency overall average DMU certain j in period i and the value of the coefficient lies between 0 to 1. Interpretation the coefficient can be explained as follows: the closer to zero the lower the level of disparities between sub-sectors in the manufacturing industry in the period j. And vice versa closer value, the greater the disparity between the level of sub-sectors in the manufacturing industry in the period j.

Results and Discussion

Research on the efficiency of the manufacturing industry using DEA analysis method that measures the average level of efficiency of the manufacturing industry sector in Indonesia in 2011, 2012, and 2013. DEA analysis, researchers were able to show a measure of efficiency that ranges between 1-100 happened to 24 sub-sectors of the manufacturing industry in Indonesia during the study period. Score 100 describes the ability of sub-sectors that have to optimize all available resources, whereas when a score of 100 then away from an industry sector can be said to not have the ability to optimize their resources. Technical efficiency describes the production costs to be incurred to produce a specific output. User input determines the level of production reached a form efficient or not. The increase in technical efficiency shows that the use of smaller input can be used to generate the same amount of output. Technical efficiency can also be interpreted with the same amount of user input can produce far greater output. This possibility can occur for example with better production techniques.

From the results of efficiency analysis conducted by the DEA method shown in the graph to give an idea of achieving average efficiency levels in the 24 sub-sectors in 2011, 2012 and 2013 and the complete calculation results in Figure 3.

Figure 3. The Efficiency of Manufacturing Industry Subsector Indonesia 2011

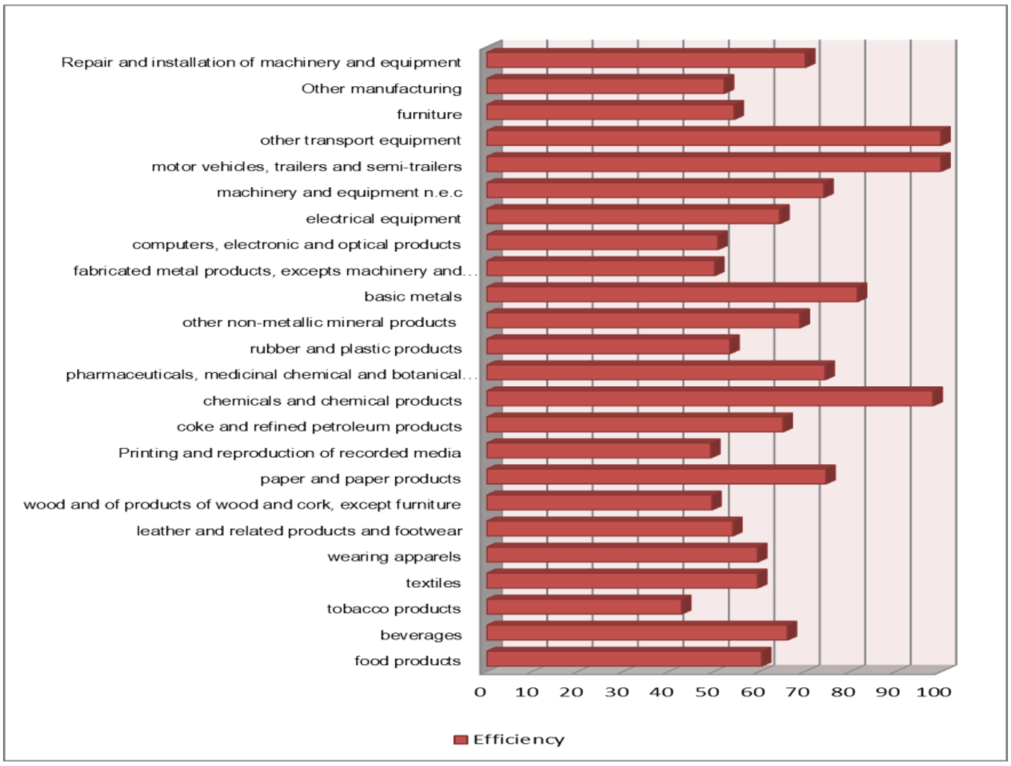
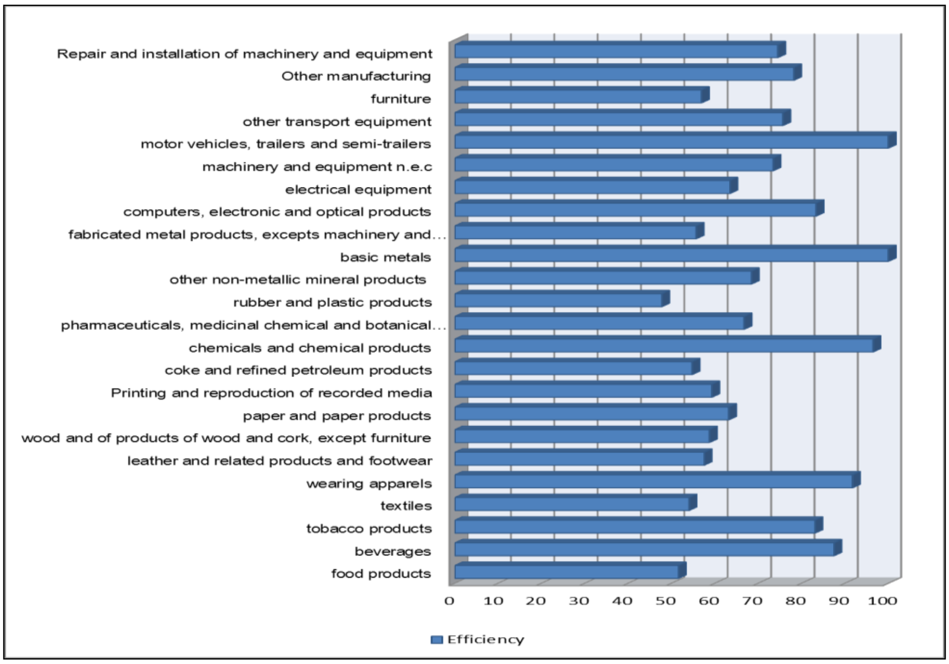


Figure 4. The Efficiency of Manufacturing Industry Subsector Indonesia 2012

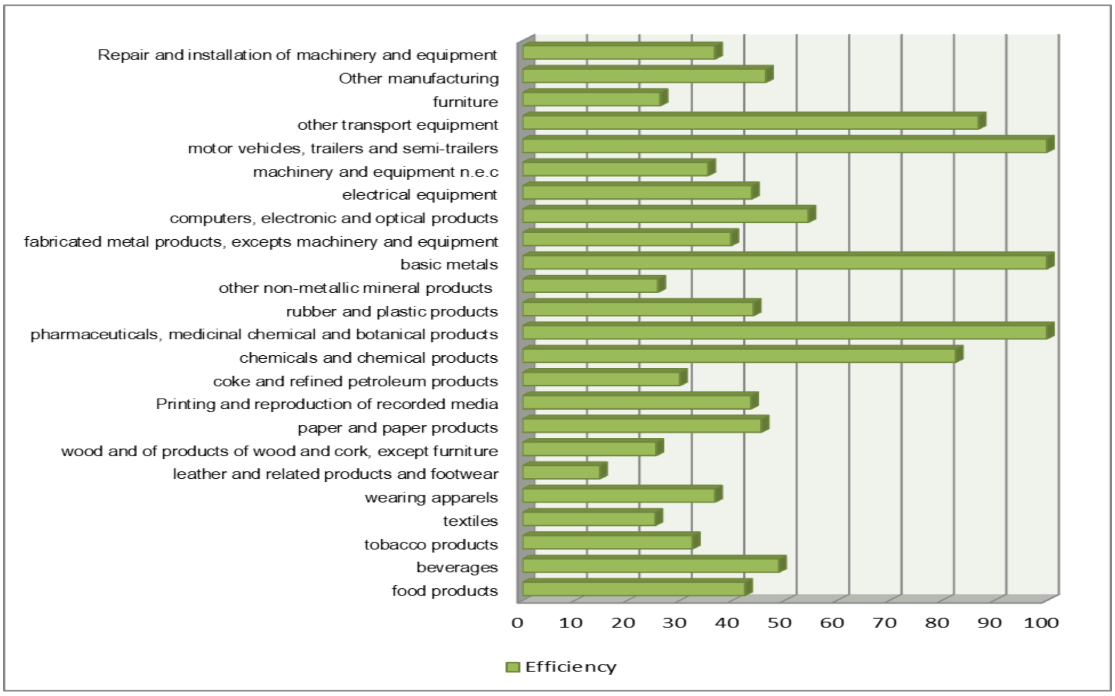
Based on the results of measurement of efficiency in manufacturing industries in Indonesia in 2012, as shown in Figure 4 shows that the achievement of the lowest efficiency is at the subsector Rubber, Rubber and Plastics Products from reaching 47.76, while the subsector with achieving the highest efficiency occurs at the Primary Metals industry sector and subsector industrial Motor Vehicles, Trailers and Semi-Trailers ie, each by 100. Unlike the situation in 2011, the average level of efficiency in industry Transport subsector decreased from 100 to 75.68 in 2012 and became 86.97 in 2013. from the analysis by the DEA method, showing that the industrial subsector Rubber, Rubber and Plastics Manufactures of which are labor-intensive and low technology have the ability to optimize resource lows only reaching 47.76 in 2012, down compared to the situation in 2011 was 53.56 and in 2013 dropped to 44.06.



From the analysis of the DEA method, that in 2011, the sub-sectors that have the value of the low efficiency of the sub-sectors that are a labor intensive technology with minimal as the sub-sector Tobacco Manufacturing subsector Wood, Cork, Weaving, Rattan and subsectors Printing and Reproduction Media Recording. The allocation of the sub-sector input to these industries less than the maximum in generating output. As with the sub-sector and sub-sector Transport Equipment Motor Vehicles, Trailers Semi-trailers tend to be capital intensive to have an average efficiency level is high.

In 2012, the average efficiency rate of Tobacco Manufacturing subsector increased to 83.1 and in 2013 fell to 32.43. At subsector Wood, Cork, Matting, Rattan in 2012 also showed the increase in the average level of efficiency becomes 58.73, but fell in 2013 to 25.51. Then the level of efficiency in the subsector Printing and Reproduction of Recorded Media also showed rising levels of efficiency into a 59.29 average in 2012 and in 2013 dropped to 43.58.

Figure 5. The Efficiency of Manufacturing Industry Subsector Indonesia 2013

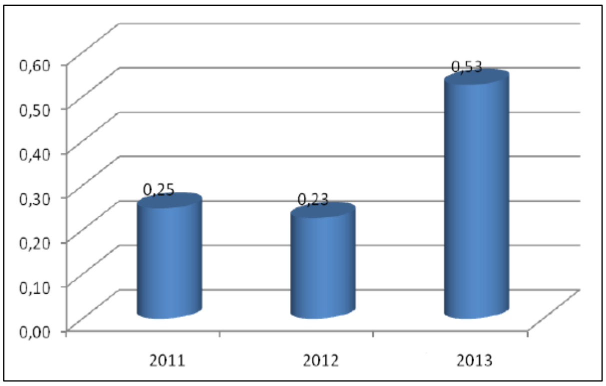


The results of the analysis with the DEA in 2013 that the level of efficiency in manufacturing industries in Indonesia as shown in Figure 5 shows that the achievement of the lowest efficiency is at the subsector Leather, leather goods and footwear, which reached 14.74 earlier dropped from 54.19 in 2011 and 57.54 in 2012. the highest efficiency in 2013 is in sub-sectors of Pharmaceuticals, Chemicals Medicinal Products and Traditional medicine and Primary Metals subsector and Motor Vehicles, Trailers and Semi-Trailers, each showing of 100. Sub Base Metal industry during the period 2011-2013 have shown improvement in the optimization of resources used. Likewise, the sub-sectors of Pharmaceuticals, Chemicals Medicinal Products, and Traditional Medicine during 2011-2013 shows that after declining from 74.52 in 2011 and became 66.74 in 2012 and then became very efficient in 2013.

In general, the level of efficiency in virtually Indonesia all sub-sectors of manufacturing industry decreased in 2013. in addition to those already mentioned her bag, a decrease in the sub-sector of Food, Beverages, Tobacco Processing, Textile, Garment, Wood, Cork and Bamboo Woven Rattan, Paper and Articles of Paper, Printing and reproduction Media Records, Product coal and Refining Petroleum, Rubber, Articles of Rubber and Plastic Goods Excavated not Metal, Metal Goods, not Machines and Fittings, Computers, Electronics and Optics, Electrical Appliances, Furniture, Processing and Repair Services and Installation Engineering. While the achievement of the subsectors with the highest efficiency in the industry subsector Pharmaceutical Products Medicinal Chemistry and Materials Chemistry and industry sub-sectors of Motor Vehicles, Trailers and Semi-Trailers making amounted to 100. Unlike the situation in 2011, the average level of efficiency in the industry subsector Tools transport has decreased from 100 to 75.68 in 2012 and became 86.97 in 2013. from the analysis by the DEA method, showed that in 2013 most of the sub-sectors have a lower ability to optimize resources in generating output.

Based on the calculation of disparity in efficiency, the disparities between sub-sectors in the manufacturing industry between the years 2011-2013 as seen in Figure 6 the following. In 2013 figures Coefficient of Variation (CV) in manufacturing industries in Indonesia showed the highest rate of 0.53 compared to its previous state in 2011 was 0.25 and in 2012 amounted to 0.23.

Figure 6. Efficiency Disparities Manufacturing Industry 2011-2013



Interpretation CV is getting close to zero the lower level of disparities between sub-sectors within the manufacturing sector in certain periods and getting closer to the value of the greater degree of disparity between sub-sectors in the manufacturing industry in certain periods. Overall, therefore, there has been increasing the disparity in the efficiency of Indonesian manufacturing industry between 2011, 2012 and 2013. In 2011 the GDP growth rate of the manufacturing industry Indonesia showed admirable conditions, from 4.7% in 2010 jumped to 6.1% in 2011 and then the GDP growth rate of the manufacturing sector declined in 2012 and 2013 to 5.7% and 5.6%. While the contribution of manufacturing sector to GDP in 2011 decreased from 24.8% in 2010 to 24.34% in 2011 and then continued to decline in 2012 and 2013, to 23.97% and 23.70%. The manufacturing industry in the shadow of industrialization as feared by many people. Since the financial crisis in 1998, Indonesia's manufacturing industry has not fully recovered.

Having improved the rate of GDP growth in the manufacturing sector in 2011, in 2012, hopes to pump up the performance of the manufacturing industry Indonesia still has not been executed because of their policy of the Indonesian government in the rising prices of fuel oil and the electricity tariff. While the state of the economy of developed countries such as Europe and North America that have not recovered from the financial crisis becoming a threat to Indonesia's manufacturing industry. Hope for Indonesia's manufacturing industry relies on Asia and the Middle East. But vigilance is still to be maintained given the reverberations ASEAN China Free Trade Area more so since its creation in 2010. With the advent of the ASEAN-China Free Trade Area, China mainly manufactures a variety of products will be more and more into the territory of Indonesia. Weakening demand for products imported from countries that are struggling with the economic crisis, to encourage China to carry out attacks exports products to countries across Asia, including Indonesia. Indonesia's manufacturing industry is export oriented with raw materials that have a high content of imported products are also very vulnerable to the onslaught of products of China's manufacturing industry.

In 2013, Indonesia's manufacturing industry performance declines with decreasing GDP growth rate of the manufacturing sector to 5.6% from 5.7% in 2012. Subsector-based labor-intensive and low-tech experience decrease of efficiency in the utilization of inputs to produce outputs. Some export-oriented industries are also affected by the slowdown demand of European countries and the United States on imports of Indonesian goods, such as textiles, apparel, leather, leather goods, and footwear, furniture. helped also felt in the manufacturing industry in 2013.

Conclusion

The construction industry requires investment sector use of technology, organizational skills, and management. It is an inevitable development of capital intensive industries often causes dependence on capital, technology and expertise that is generally foreign owned. The growth rate of the manufacturing industry in 2011 is the highest achievement of the highest growth since the economic crisis hit Indonesia. However, uncertainty in the world economy is still potentially lower demand for the products of Indonesian manufacturing industry. Indonesia's manufacturing industry performance needs to be improved and one factor is to improve the efficiency of manufacturing processing industry.

The low value of the efficiency of the manufacturing industry subsector Indonesia in 2011-2013 due to the allocation of less than the maximum input in generating output. Subsector which has a low value is a labor-intensive sub-sectors are loaded with the power of the human family and the technology has not been widely used so enhancements relatively small value. In addition, disparities occur between subsector efficiency in the manufacturing industry showed a rise in the years 2011, 2012 and 2013. The findings of this study indicate that the government's policy to improve the performance of the manufacturing industry has not impacted on productivity improvement characterized by increased efficiency in all sub-sectors of the manufacturing industry. Various problems facing Indonesian manufacturing sector is not fully able to overcome. However, Indonesia still has hope in improving the performance of the manufacturing industry by opening opportunities for exports to countries that did not experience a financial crisis which has high purchasing power and a large population. Settling in the manufacturing sector is also a necessity to overcome the obstacles and limitations such as transport infrastructure, technology, and production equipment is old, the procurement of raw materials are loaded with imported ingredients and other barriers that interfere with the performance of the manufacturing industry in Indonesia. This research only use two-digit industry data covering 24 sub-sectors of the manufacturing industry. For future research, the researchers can use 3-digit ISIC data.

References

Abbott, M and Doucouliagos C. (2003). The efficiency of Australian universities: a Data Envelopment Analysis. *Economics of Education Review*. 22 (1), 89–97

Banker, R.D., Charnes, A., and. Cooper, W.W., (1984), Some Models for Estimating Technical and Scale Efficiencies in Data Envelopment Analysis, *Management Science* 30 (9), 1079-1092.

Charnes, A., W. Cooper, and E. Rhodes, (1978), Measuring the Efficiency of Decision Making Units, *European Journal of Operational Research*..2 (6), 429–444

Farell, M.J, (1957), The Measurement of Productive Efficiency, *Journal of the Royal Statistical Society, Series A,* 120 (3), 253-281.

Giufrida, A., and Gravelle, H., (2001), Measuring Performance in Primary Care: Econometric Analysis and DEA. *Paper*. Department of Economics and Related Studies University of York, Heslington, York.

Kao, Chiang and Shiun Nan Hwang, 2008. Efficiency decomposition in two-stage data envelopment analysis: An application to Non-Life Insurance Companies in Taiwan. European Journal of Operational Research. 185 (1) 418–429

Lestari, E.P., (2007), Disparity Between Sub-Sector Technical Efficiency In Industry Manufacturing In Indonesia, Application Data Envelopment Analysis *Journal of Organizational and Management*, downloaded on site http://lppm.ut.ac.id/JOM/jom%20volume%203%20no%201%20maret%202007/02ettypl.pdf

Lestari, E.P., (2015). Lestari, E.P. (2015) Assessing the Efficiency of UPBJJ-UT Semarang Using Data Envelopment Analysis. *International Journal of Information and Education Technology*. 5 (4) April, p. 292-296.

Insukindro, Nopirin, Makhfatih, A., Tjiptono, S.M., (2000). *Final Report Relative Efficiency Measurement Services Branch Pawn*, Research and Development of Management (PPM) Faculty of Economics, University of Gadjah Mada, Yogyakarta.

Jefferson, G.H and Xu,W, (1994), Assessing Gains in Efficient Production among China's Industrial Enterprises, *Economic Development and Culture Change*, 42(3), 597-615

Muchdie, (1998), The Indonesian Economic Space Structure Modeling: Application Procedures Griot to Develop Input-Output Table of Regions, *Economy, and Finance of Indonesia*, XLVI (3). 279-305

Post, Thierry, and Spronk, J., (1999), Including Economic Uncertainty in Data Envelopment Analysis; With an Application of Large European Commercial Banks, *Helsinki School of Economics*, Finland.

Zhanh. Bing, Jun B, Ziyin F, Yuan. Z and Junii Ge. (2008). Eco-efficiency analysis of industrial system in China: A data envelopment analysis approach. *Ecological Economics*. 68 (1-2) p. 306-316