Super Slack Efficiency

by Tessa Soetanto Pei Fun Liem

SUPER SLACK-BASED MODEL EFFICIENCY AND STOCK PERFORMANCE OF MANUFACTURING INDUSTRY LISTED IN INDONESIAN STOCK EXCHANGE

Tessa Vanina Soetanto, S.T., M.Com.
Liem Pei Fun, S.E., M.Com.
International Business Management Program
Faculty of Economics
Petra Christian University
tessa@petra.ac.id, pfun@petra.ac.id

Abstract

Manufacturing sector in Indonesia has contributed steadily to GDP and plays an important role as the government has already prepared some crucial moves such as strengthening industry structure and escalating the industry environment in welcoming Asian Economic Community (AEC) 2015, including to cut back cost of capital, energy and logistic. This research examines the efficiency of Indonesian manufacturing industry listed in Indonesian Stock Exchange during the period of 2010-2014 using non-parametric output oriented Super Slack-Based Model (SBM) proposed by Tone to take account the input and output slacks that represent the input excesses and output shortfalls. Furthermore, resulted changes of efficiency score are regressed on stock performance to know the relationship. 77 companies in manufacturing industry classified as basic, miscellaneous and consumer goods industry listed in Indonesian Stock Exchange during 2010-2014 which resulted in 308 pooled data is being analyzed. The input variables used in this paper are salary wages and benefit, raw materials cost, net fixed asset while the output variable is earning before tax. This research shows that on average the highest output oriented Super SBM efficiency is miscellaneous industry while basic and consumer goods industry are not efficient on average. Also, there are existence of input excesses and output shortfalls in three types of manufacturing industry and analysis of the effect to stock performance is conducted, revealed that change in efficiency, assets and risk are all positive and statistically significant.

Keywords: efficiency, stock performance, Super Slack-Based Model

1. Introduction

Manufacturing sector is becoming the imperative factor in East Asia (Liao et al, 2007) and frequently discussed in the research papers. As Nehru (2013) pointed out that manufacturing create needs for inputs and corresponding outputs from other sectors (ie. agriculture and service) that lead to economy growth and employment. For Indonesia, manufacturing sector also plays a crucial role as can be proven by the facts that, the government of Indonesia has already prepared some crucial moves such as strengthening industry structure and escalating the industry environment in welcoming Asian Economic Community (AEC) 2015. Those are including to cutback cost of capital, energy and logistic. Not to mention to enlarge research and development as well as to improve the labors capability in manufacturing sector (Bank Indonesia, 2014).

In the last 3 years, Indonesian economy has experienced a sluggish growth from 6.03 percent in 2012, 5.58 percent in 2013 and 5.02 percent in the year of 2014. This condition is triggered by the declining of export growth, in particular the natural resources commodities (Bank Indonesia, 2014). Whereas GDP in 4th Quarter of 2014 was improving 5.01 percent compared to the same period in 2013. Total value of export in the year of 2014 reached US$ 176.29 billion, 3.43% decrease from year of 2013 and the non-oil and gas export value is also experiencing a decline, 2.64% less compared to the 2013.

However, manufacturing industry is contributed steadily to GDP in the last 3 years, from 21.46% in 2012, 20.98% in 2013 and it is slightly going up to 21.02% in 2014 and it is indeed the foremost contributor compared to other sectors (BPS Report, Feb 2015). From 2009-2013 there are 71.3 million people that worked in manufacturing industry primarily in the industry of food and beverage and industry of tobacco for 28% (Bank Indonesia, 2014). Besides farming, trading sector and service industry, manufacturing is the biggest industry that employs labors (15.26% per August 2014, BPS Feb 2015).

Most of the previous researches have been seeking to know how efficient the manufacturing sector were and this research being extended to measure not only efficiency but also the relationship with the stock returns together with other factors such as productivity as both of them have significant implications to decision makers in the organizations such as shareholders, managers and investors. Numerous studies about measuring efficiency *or productivity* using DEA in various industries worldwide such as banking industry (Galagedera and Edirisuriya, 2004), garment industry (Joshi and Singh, 2010), international airports (Yang, 2010), manufacturing industry (Chang and Wu, 2007; Liu and Wang, 2008), agriculture industry (Selamat and Nasir, 2013), retailers (Gandhi and Shankar, 2014).

Prior to date, there are many researches have been conducted to examine the efficiency or productivity of manufacturing firms in Indonesia. Using stochastic frontier model (parametric approach), Margono and Sharma (2006) studied Indonesian manufacturing industry from 1993-2000 and founded the decreasing rate of productivity in most of industries except chemical sector. Using same method, Mojo (2007) analyzed the magnitudes of productivity growth and technical efficiency changes of Indonesian manufacturing industry from 1998-2000 to consider the effect after economic crisis in 1997 and resulted that yearly average of technical efficiency went down by 1.47% although some industries experienced an increase. Besides, the productivity growth per year was 2.87% during the period and it triggered by technical progress that contributed 3.98% in average. Prabowo and Cabanda (2011) studied of Indonesian firms' efficiency listed in Indonesia Stock Exchange (IDX) during year of 2000-2005 using stochastic frontier approach. In addition, Viverita and Ariff (2008) used Malmquist DEA to measure the productivity of state and non-state firms during period of 1992-2001 and found that there is productivity decline in these sectors that caused by technological regressions.

The aforementioned papers that use standard DEA assume that reduction of unfavorable inputs (outputs) is balanced with the increase of favorable outputs thus it is implicating the efficiency scores estimation disregard the inputs and output slacks (Liu, 2009) and further, the scores resulted may not fully revealed the facts in the slacks. This paper differs from previous works that studied about manufacturing industry in Indonesia for it employs a DEA model that takes account the input and output slacks that represent the input excesses and output shortfalls (Tone, 2001), called Slack Based Model (SBM). Liu and Wang (2007) also mentioned the significance of examining efficiency ratio and also the slacks as they can refer to different result or solution. Not only limited to that, this study also applies another approach by Tone (2002) that is Super SBM, to rank the efficient DMUs.

There have been several researches in the past that applied the Super SBM (Tone 2001, 2002) to measure firms' performances such as Duzakin and Duzakin (2007) that analyzed the performance of 500 major manufacturing firms in Turkey during the year of 2003 and both for overall firms and for specific industries were being examined. Resulted that 9 firms was efficiently performed and firms were ranked within each industry, given total of 65 firms were operating efficiently. Further, the analysis showed which inputs and outputs directed to inefficiency together with the degree of surpluses and losses. Using the same method combined with Malmquist Index, Hadad et al (2008) studies the productivity change of Indonesian banks over the period of January 2006 to July 2007. Under intermediation approach to efficiency estimation, the average of bank efficiency was rationally firm, given the scores between 70% and 82% and leaded to 92 out of 130 banks have efficiency above 70%. In addition, Liu (2009) applied SBM approach to estimate the performances of 24 commercial banks in Taiwan and concluded that the method was able to predict the efficiency scores and discover some operational matters of the banks in advance. Furthermore, Lozano and Guierrez (2011) also utilized the same approach to measure the efficiency of 39 airports in Spain for the period of 2006-2007, while Bi et al. (2014) was using input-oriented SBM approach to calculate China's energy and environmental efficiency of power generation sectors that leads to supplementary information about energy usage and environmental protection.

The next stage in this research is to find the relationship between the efficiency and some other control variables to stock return. By measuring the performance of the firms, it could be seen whether efficient firms perform differently in comparison with inefficient firms towards stock return and other variables selected. Various and very large amount of researches in the past has been done to seek the relationship between efficiency of the firms and the stock returns, particularly in the banking sector as Beccalli, Casu and Girardone (2006), Liadaki and Gaganis (2010) in European Union, Ioannidis, Molyneux and Pasiouras (2008) in Asia and Latin America, Hadad et al. (2008) in Indonesia, Gue and Yue (2011) in China and Vardar (2013) in transition countries.

Some closely related research to this study is the work by Frijns, Margaritis, and Psillaki (2012) that employed DEA analysis to calculate efficiency of the firms based on several combination of inputs and outputs variables in US publicly listed firms during 1988-2007 and perform cross-sectional regressions and found that there is indeed relationship between firm efficiency and stock returns. Gaganis, Hasan and Pasiouras (2013) examined whether stock returns of listed insurance firms has relationship with the cost and profit efficiency in 52 countries during 2002-2008 period and the result is profit efficiency alone affected stock returns.

2. Methodology

2.1. Super Efficiency

DEA is a non-parametric linear programming method that introduced by Charnes, Cooper and Rhodes (1978) or CCR model to measure relative efficiency of decision-making units (DMUs) that are employing multiple inputs to produce multiple outputs. DEA's objective is to build the efficient frontier (efficient) units (score of 1) by enveloping those DMUs with minimum input level for given output levels and otherwise. Whereas the inefficient unit will be having score less than 1.

There are two types of DEA, radial and non-radial model. Radial model means the changes between input and output will be proportional and efficiency value will be calculated without concerning the slack for both CCR model (Charnes et al., 1978) or later DEA model by Banker, Charnes, and Cooper or BCC model (1984). On the other hand, non-radial model means the changes of input and output will be at dissimilar level and slack will be take into account. Fare and Lovell (1978) developed the non-radial model at the beginning (Tone, 2001).

Slack-Based Model (SBM) was introduced by Tone (2001), is a non-radial DEA model which is calculating the efficiency score ponder the account input and output slacks and giving result between zero and 1, the same with radial model (Charnes et al., 1978). This model is not the same with the Additive model by Charnes et al. (1985) that also emphasize on dealing with the excesses of input and the shortfalls of the output but there is no scalar measurement. Then, it is leading to no profundity assessment related to inefficiency eventhough this model is able to differentiate between efficient and inefficient DMU (Liu and Wang, 2008). The most important attributes of SBM by Tone (2001) are invariant respective to the measurement units and monotone decreasing in each input and output slack.

There is j=1,…., n DMU with X_{ij} represents multiple inputs (i=1,….m) and Y_{rj} (r=1,….s) represents multiple outputs of DMUj. While s_i^- and s_r^+ as the slack variables for ith input and rth output, λ_j represents the weight of DMUj during the performance measurement of DMU_0.
Then SBM model will be as follows, to evaluate of DMU_0 under the assumption of constant returns to scale (Tone, 2001):

$$\min \ \rho = \frac{1 - \frac{1}{m}\sum_{i=1}^{m} s_i^- / x_{i0}}{1 + \frac{1}{s}\sum_{r=1}^{s} s_r^+ / y_{r0}}$$

$$subject\ to\ x_0 = X\lambda + s^-$$
$$y_0 = Y\lambda - s^+$$
$$\lambda \geq 0, s^- \geq 0, s^+ \geq 0$$

The model assumed that X ≥ 0, if $x_{i0} = 0$, then the term s_i^-/x_{i0} is being removed from the objective function. If the optimal solution for SBM is (ρ*, λ*, s^-* and s^+*) then DMU_0 (x_0, y_0) is SBM efficient if ρ *= 1 which is corresponding with s^-* = 0 and s+* = 0, as no slack variables for input (input excess) and no slack variables for output (output shortfall) in an optimal solution. It is providing an efficiency score between 0 and 1.

The best DMU will have efficiency of unity and the rank of these efficient units cannot be differentiated between themselves. At first, Andersen and Peterson (1983) had developed super efficiency for both CCR and extension of CRR or BCC model to provide the ranks or differentiate the efficient units (in Zhu, 2009). However the data of efficient DMU_0 is being eliminated from the solution set (Cooper, Seiford and Tone, 2007). Therefore Tone (2002) developed Super SBM model to improve and assume DMU_0 is SBM efficient, p* = 1, Super SBM will be as:

$$\min \delta = \frac{\frac{1}{m}\sum_{i=1}^{m} \bar{x}_i / x_{i0}}{\frac{1}{s}\sum_{r=1}^{s} \bar{y}_r / y_{r0}}$$

$$subject\ to\ \bar{x} \geq \sum_{j=1,\neq 0}^{n} \lambda_j x_j$$

$$\bar{y} \leq \sum_{j=1,\neq 0}^{n} \lambda_j y_j$$

$$\bar{x} \geq x_0\ and\ \bar{y} \leq y_0,$$

$$\bar{y} \geq 0, \quad \lambda \geq 0$$

Dealing with the negative outputs in the efficiency calculation of SBM is a crucial matter needs to be considered. As being introduced in DEA Solver Pro 4.1 (Cooper, Seiford and Tone, 2004), a new arrangement was introduced as follows:

$$\text{if } y_{r0} \leq 0, \text{ then } \begin{cases} \bar{y}_r^+ = \max_{j=1,\ldots,n} \{y_{rj} \mid y_{rj} > 0\} \\ \underline{y}_r^+ = \min_{j=1,\ldots,n} \{y_{rj} \mid y_{rj} > 0\} \end{cases}$$

9

if the output r has no positive components, then it is defined as $\bar{y}_r^+ = \underline{y}_r^+ = 1$. It is replaced s_r^+/y_{r0} in the objective function as following way :

$$\begin{cases} if\, \bar{y}_r^+ > \underline{y}_r^+, it\ is\ replaced\ by\ s_r^+ \Big/ \dfrac{\underline{y}_r^+(\bar{y}_r^+ - \underline{y}_r^+)}{\bar{y}_r^+ - y_{r0}} \\ if\ \bar{y}_r^+ = \underline{y}_r^+, it\ is\ replaced\ by\ s_r^+ \Big/ \dfrac{\left(\underline{y}_r^+\right)^2}{B(\bar{y}_r^+ - y_{r0})} \end{cases}$$

where B = is large positive number

The preferred objective of SBM model in this research is to maximize the output (output oriented) with the current amount of observed inputs. The same reason as in Duzakin and Duzakin (2007) that one of the input variables which is amount of salaries, wages and benefit related to the labor force and to minimize it will lead to severe social consequences. Tone (2002) developed output oriented Super SBM as follows:

$$\min \delta = \frac{1}{\frac{1}{s}\sum_{r=1}^{s} \bar{y}_r / y_{r0}}$$

$$subject\ to\ \bar{x} \geq \sum_{j=1,\neq 0}^{n} \lambda_j x_j$$

$$\bar{y} \leq \sum_{j=1,\neq 0}^{n} \lambda_j y_j$$

$$\bar{x} = x_0\ and\ 0 \leq \bar{y} \leq y_0,$$

$$\lambda \geq 0$$

2.2. Panel Regression

1 47

Stock performance is calculated on the basis of monthly returns using the cumulative annual stock returns (CASR) in the following formula:

13

CASR in year t = ((1 + month 1 return)*(1 + month 2 return)* . . . * (1 + month 12 return)) – 1

Becalli, Casu and Girardone (2006) said daily stock returns is a better measure rather than monthly stock returns, however due to the availability of the data in this research then only monthly stock returns were obtainable and CASR were calculated (Liadaki and Gaganis, 2010; Vardar, 2013).

Next stage is to evaluate the relationship between stock return performance and the efficiency, cumulative annual stock returns (CASR) is being regressed to changes in the efficiency and several corporate control variables, annual change in total asset to control size and annual change in total equity to total assets ratio to control the risk or solvency ratio (Liadaki and Gaganis, 2010; Gue and Yue, 2011; Gaganis, Hasan and Pasiouras, 2013; Vardar, 2013) of the corporation. Changes in the efficiency is in favor based on the fact that investors who would make investment in manufacturing sector industry will able to obtain the information about the change of firm efficiency between the year t and year t-1, instead of year t (Vardar, 2013).

The regression model is estimated:

$$CASR_{i,t} = \alpha + \beta_1 CHGEFF_{i,t} + \beta_2 CHGASSET_{i,t} + \beta_3 CHGRISK_{i,t} + \beta_{4\text{-}7} \ YearDummies + \varepsilon_{i,t}$$

Where for corporate i, time t : $CASR_{i,t}$ is cumulative annual stock return, $CHGEFF_{i,t}$ denotes efficiency change, $CHGASSET_{i,t}$ is annual change in total asset and $CHGRISK_{i,t}$ is annual change in total equity to total assets ratio, α is overall constant in the model, β_j (j=1,2,3,4…7) represents slope parameters, $\varepsilon_{i,t}$ denotes the error terms and year dummy variables are also included in the model to measure the potential time effects in the stock returns.

Since using OLS regression is making the result biased as the difficulty to meet the assumption of independence and homocedasticity of error terms in the panel data as the corporations' observations within themselves is likely to be correlated. Then the panel regression is being used and as generally written in the previous literatures (Baltagi, 2013; Liadaki and Gaganis, 2010, Gaganis, Hasan and Pasiouras, 2013; Vardar, 2013) about the selection of fixed effect (FE) and random effect (RE), several tests are conducted as Breusche-Pagan Lagrange Multiplier (LM) and Hausman's test. Besides, in controlling cross-section heterocedasticity that would affect the result, White's tranformation with corrected degree of freedom is employed in the model.

3. Data and Variables

There are 77 manufacturing companies' data taken from the year of 2010-2014, a total of 308 data that is representing a balanced panel data. The companies taken as sample must be publicly listed before the year of 2010 to acquire representative evaluation. Annual Reports, Financial Statements of the companies and monthly stock prices of companies in the samples are collected from Indonesia Stock Exchange (IDX) and corporations' website.

The selection of the inputs and outputs variable being used in DEA studies always be a foremost matter since it can lead to misleading conclusions (Duzakin and Duzakin, 2007). There are several studies in manufacturing industry beforehand along with the input and output variables as listed in Table 1 below.

Table 1. Input and Output Variables in previous research

Input Variables	
Net assets	Duzakin and Duzakin, 2007
Fixed assets	Margono and Sharma, 2006; Chang and Wu, 2007; Duzakin and Duzakin, 2007; Joshi and Singh, 2010; Prabowo and Cabanda, 2011, Frijins, Margaritis and Psillaki, 2012
Depreciation expense	Viverita and Ariff, 2008
Labor cost	Prabowo and Cabanda, 2011; Chang and Wu, 2007; Viverita and Ariff, 2008; Joshi and Singh, 2010
Number of labor force	Margono and Sharma, 2006; Chang and Wu, 2007; Duzakin and Duzakin, 2007
Material used cost	Margono and Sharma, 2006; Joshi and Singh, 2010; Viverita and Ariff, 2008
Energy and fuel	Margono and Sharma, 2006; Joshi and Singh, 2010
Expenditure R&D	Chang and Wu, 2007
Gross value added	Duzakin and Duzakin, 2007
Output Variables	
Sales	Chang and Wu, 2007; Joshi and Singh, 2010; Prabowo and Cabanda, 2011; Viverita and Ariff, 2008, Frijins, Margaritis and Psillaki, 2012
Earning before tax	Duzakin and Duzakin, 2007; Viverita and Ariff, 2008
Export revenues	Duzakin and Duzakin, 2007

Many of previous research is using sales or net sales as their output but Duzakin and Duzakin (2007) showed that a company that achieves high amount of sales but failed to meet a satisfactory profit margin will lead to misleading company's performance. Therefore this study is using salary, wages and benefits to represent labor cost; fixed assets, net; material used cost as the input variables and earning or profit before tax as the output variable.

For the regression, as explained in 2.2., the dependent variable is stock performance calculated using the cumulative annual stock returns (CASR) while the independent variables are changes in the efficiency, annual change in total asset to control for size and annual change in total equity to total assets ratio to control for risk or solvency ratio.

4. Results and Analysis

4.1. Descriptive Statistics

Table 2 below shows descriptive statistics of input and output variables used in the efficiency estimation as well as variables used in regression.

Table 2. Descriptive Statistics

Variables	Mean	Median	Standard Deviation
Panel A: Variables used in the efficiency estimations			
Inputs:			
Salary, Wages, and Benefits	Rp 488.242.643.456	Rp 113.999.630.000	Rp 1.323.708.520.609
Material Used Costs	Rp 4.093.400.588.517	Rp 1.017.017.264.000	Rp 13.357.385.219.402
Fixed Assets	Rp 3.016.354.195.385	Rp 677.473.284.056	Rp 6.174.499.657.540
Outputs:			
Earnings Before Tax	Rp 1.130.502.847.713	Rp 71.883.000.000	Rp 3.519.337.967.020
Panel B: Variables used in the regression			
Annual Change in Total Equity to Total Assets Ratio	-0,03834	-0,00159	0,69688
Annual Change in Total Asset	0,15734	0,12686	0,17925
Annual Efficiency Change	26,75051	-0,07794	272,43077
Cumulative Annual Stock Return	0,35561	0,14631	0,66897

From table 2, it can be seen that on average, based on nominal term, material used costs is the highest input variable compared to other input variables namely salary, wages and benefit and fixed assets. Material used costs also has highest standard deviation since there is a company in the data which is ASII that has extremely high material used costs in nominal term compared to other companies in the data. For the output variable, mean of earning before tax is higher than its median which shows that there are companies that has superior performance or extremely high earning before tax, in nominal term, compared to their peers. Company that has the highest earning before tax is ASII. For regression variables, mainly total assets each year is keep increasing while annual change in total equity to total assets ratio on average shows declining trend.

4.2. Result of Super Efficiency

As presented in Table 3, the result of SBM Efficiency and Super SBM Efficiency overall mean for 308 firms in manufacturing sector during the period of 2010-2014 is 0.3702 and 0.9465. The result of Super SBM is higher due to some firms are having higher efficiency score (≥1) in the condition of having efficient SBM (=1) based on the approach by Tone (2002) as the way to differentiate between efficient firms. SBM result indicates that manufacturing sector industry in Indonesia is far from being efficient and numerous actions required for principal development. It is confirming that the firms in the sample should improve the profit by approximately 63%. The averages of SBM efficiency for manufacturing industry category (basic, miscellaneous and consumer goods) are 0.2996, 0.4619 and 0.4233. Whereas the result of Super SBM shows the efficiency score of 0.4154, 1.4723 and 0.5477. The same result shown by Prabowo and Cabanda (2011) that miscellaneous sector is having the highest efficiency.

Looking at the yearly result, it shows that the average of SBM efficiency across all firms is experiencing downward trend from 0.4226 in 2010 and reaching 0.3298 in 2013 before it is slightly moving up to 0.3350 in 2014. While Super SBM efficiency result is having upward trend from the year 2010 (0.6626) to 2011 (0.8672) before declining over the next period and attained the score of 0.4206 in 2014. The difference of Super SBM and SBM result for year 2010 to 2011 could be understood since during the year of 2011 the score of Super SBM efficiency for some efficient firms are way higher compared to the previous year though it is not adding the number of efficient firms (as seen in Table 4).

This result is supported by the data of percentage of efficient firms (Table 4) as a whole from 4.55% in the beginning of analysis period 2010 to merely as much as 2.6% in the last year of the period. That means among 77 firms, simply 8 of them are efficient and there are 4 companies consistently efficient for the whole period. They are INTP (basic), ASII (miscellaneous), HMSP and UNVR (consumer goods). Firms in miscellaneous manufacturing sector have shown to be the highest of having efficient firms from year to year.

Table 3. Result of SBM and Super SBM Efficiency

Averages by year		SBM Efficiency	Super SBM Efficiency
2010	N = 77	0,4226	0,6626
2011	N = 77	0,3920	0,8672
2012	N = 77	0,3715	0,8444
2013	N = 77	0,3298	0,7470
2014	N = 77	0,3350	0,4206
Averages by manufacturing category			
Basic	N = 39	0,2996	0,4145
Miscellaneous	N = 19	0,4619	1,4723
Consumer Goods	N = 19	0,4233	0,5477
Total Sample			
Total Sample (N = 308)		0,3702	0,9465

Table 4. Percentage of Efficient Firms

Year	Basic	Miscellaneous	Consumer Goods	All
2010	17.95%	26.32%	10.53%	4.55%
2011	12.82%	21.05%	10.53%	3.57%
2012	10.26%	26.32%	10.53%	3.57%
2013	7.69%	21.05%	10.53%	2.92%
2014	10.26%	10.53%	10.53%	2.60%

Furthermore, as mentioned previously that besides the ratio or efficiency, the emphasis on the slack (input excess or output shortfalls) is becoming significant factors that need to be focused with. In this study output oriented model is being used that has purpose to seek the output shortfalls that cause inefficiency without any changes in the input excesses. By observing output shortfalls in figure 1, it is clearly shown that requirement to increase firms' earning or profit before tax is fluctuating during the year of 2010-2014. The trend is going down from 2012 (Rp 419.648 billion) afterwards and needs to add average of Rp 316.312 billion to be efficient in

2014. Among average of excess input variables, the most constant and also the lowest is indicated by salary, wages and benefit while material used cost is the most varied.

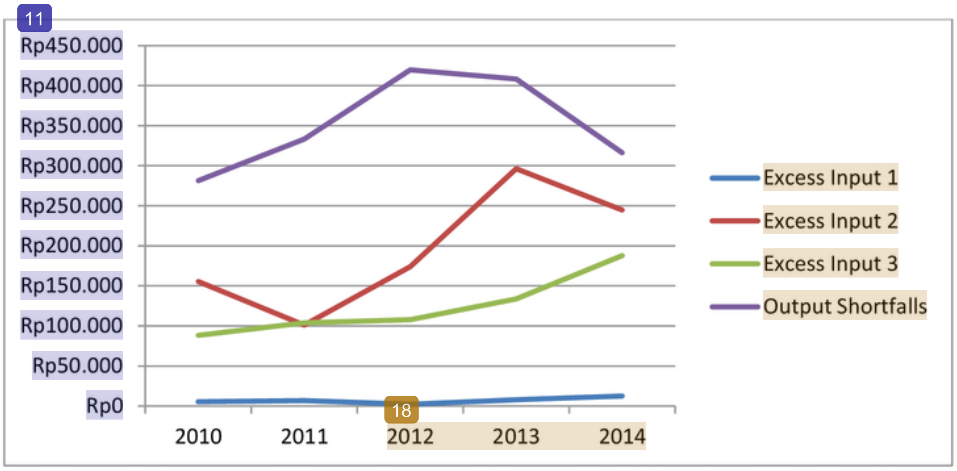

Figure 1. Average of Excess Input and Output Variables (in million Rupiah)
Excess Input 1 = salary, wages and benefit; Excess Input 2 = material used cost; Excess Input 3 = fixed asset, net; Output Shortfalls = earning or profit before tax

In addition, of the perspective of manufacturing category it indicates that the miscellaneous industry requires the least to enlarge earning or profit before tax compared to other category (figure 2) from year to year. Whereas consumer goods industry needs to increase the greatest amount of output shortfalls in order to be efficient. In figure 3 particularly miscellaneous industry is having zero input excess on salary, wages and benefit from the year of 2010-2012 before the excess input is rising up to Rp 4,566.64 million in 2014. Similar pattern also being demonstrated by input excess of material used cost (figure 4) that miscellaneous industry is the one gets the least amount and the basic industry has the highest amount of input excess. In other words, miscellaneous industry consist of automotive and components, textile garment, cable and electronics firms are able to perform more efficient in utilizing the input and producing output in comparison with basic and consumer goods industry during the sample period.

On the other hand, the data of input excess in terms of fixed cost, net as shown in figure 5 is disclosing a fluctuated pattern in those 3 categories of manufacturing industry and does not confirm any industry being the lead in the whole period.

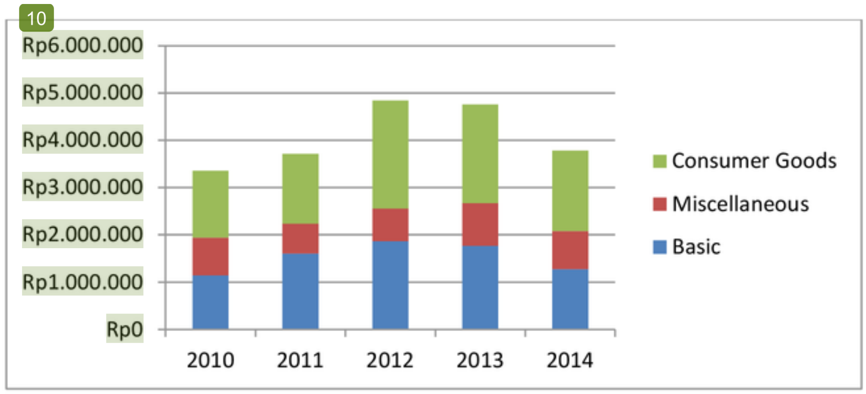

Figure 2. Average of Excess earning or profit before tax (in million Rupiah)

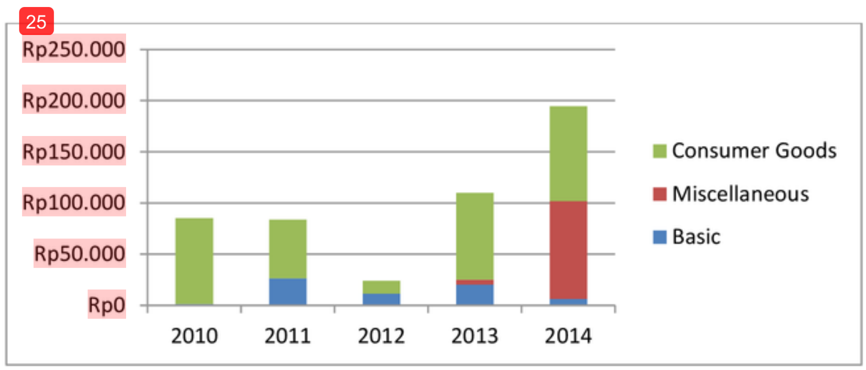

Figure 3. Average of Excess salary, wages and benefit (in million Rupiah)

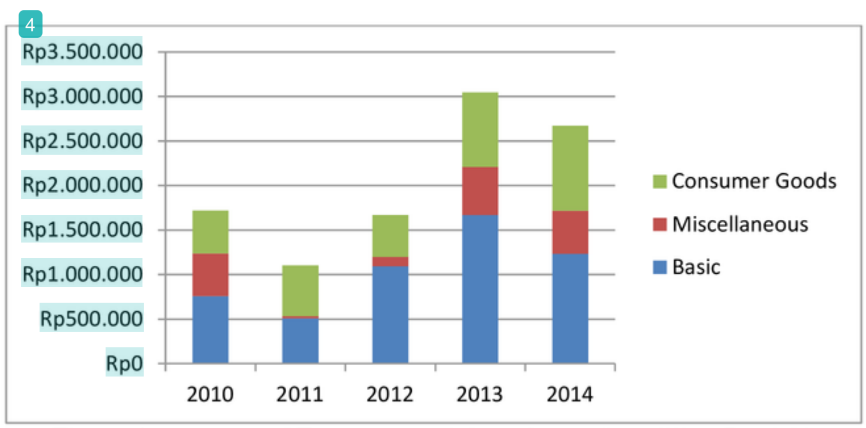

Figure 4. Average of Excess material used cost (in million Rupiah)

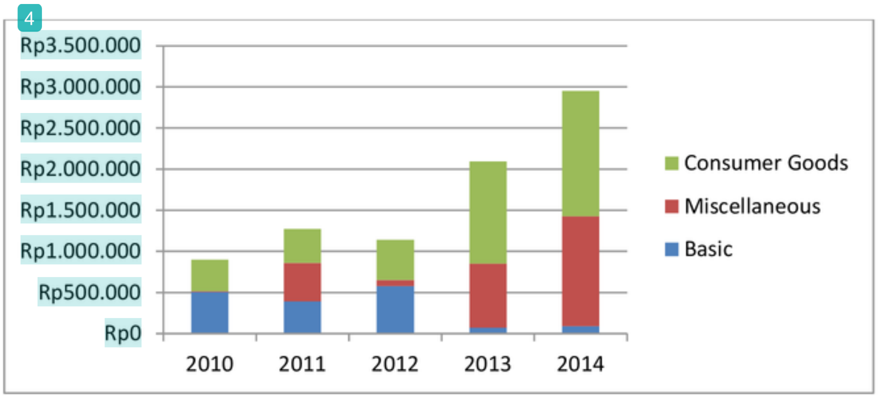

Figure 5. Average of Excess fixed cost, net (in million Rupiah)

4.3. Result of Panel Regression

Later stage of discussion is the result of the panel regression to find the relationship between the efficiency, size and solvency ratio to stock returns. Breusche-Pagan Lagrange Multiplier (LM) and Hausman's test are conducted to test whether fixed effect or random effect model should be preferred. The result of Hausman test is random effect model is preferred (Chi-square statistic equal to 1.66 with d.f =3, statistically not significant at the 5% and 10%) and White transformation is also applied to control cross section heterocedasticity.

Table 5. Panel Regression Results

Dependent Variable : CASR	Coefficient	Standard Errors	
CHGEFF	0.0001	0.0000	*
CHGASSET	0.4681	0.2047	*
CHGRISK	0.0950	0.0411	*
Constant	0.2886	0.0406	*
Year Dummies	YES		
Adjusted R-sq	0.0292		
F-Statistics	48.71**		
Hausman test	1.66		
No of Firms	77		
No of samples	308		

* and ** statistically significant at the 5% and 1%, respectively; CASR : cumulative annual stock return, CHGEFF : change in efficiency, CHGASSET : change in total assets; CHGRISK : change in equity to total assets ratio

Overall result of regression is presented in Table 5 and indicates that change in efficiency is having positive and statistically significance related to stock returns. It is suggested that the investors are concerned with the financial performance of the firms that also designate the future payments of dividends and capital gains (Vardar, 2013). Nichols and Wahlen (2004) also pinpointed the importance of persistent earnings that affects more strongly to stock returns (in Gaganis, Hasan and Pasiouras, 2013). The change of asset and change of risk (equity to total asset) are also positive and statistically significance related to stock returns. These results are consistent with previous studies as in Frijns, Margaritis, and Psillaki (2012) and Gaganis, Hasan and Pasiouras (2013).

5. Conclusions

Manufacturing sector is always being the most discussed in the research papers and for Indonesia, manufacturing sector is playing a crucial role in developing the future economics in particular and government has developed plans to strengthen the capability of this sector to welcome Asian Economics Community (AEC) in 2015. Past researches that investigate the efficiency of manufacturing sectors had been used various DEA model that is not taking into account the input excesses and output shortfalls or "slack" as they can refer to different solution. The present study contributes a first attempt in using SBM DEA by Tone (2001) to compute efficiency of 77 companies in three different categories of manufacturing sector from the period of 2010-2014 that considers the slacks and also employ Super SBM by Tone (2002) that can differentiate the efficient firms. Efficiency of manufacturing sector in average during the samples period shown inefficiency and miscellaneous industry found to have higher efficiency in comparison with the other industry. Moreover, the relationship between efficiency and stock returns is being assessed and the results indicate a positive and statistically significant relationship between the change of efficiency, change of asset, change of risk and cumulative annual stock return.

References

Baltagi, Badi H. (2013). Econometric Analysis of Panel Data. 5th Edition, John Wiley & Sons.

Badan Pusat Statistik. (2015). Laporan Bulanan Data Sosioekonomi Februari 2015.

Banker, R.D., Charnes, A. and Cooper, W.W. (1984). Some Models for the Estimation of Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, 30, 1078–1092.

Bank Indonesia. (2014). Laporan Kebijakan Moneter Ekonomi, Moneter dan Keuangan 2nd quarter.

Beccalli E, Casu B, Girardone C. (2006). Efficiency and Stock Performance in European Banking. *Journal of Business Finance and Accounting*, 33, 245-262.

Bi, et al. (2014). Does environmental regulation affect energy efficiency in China's thermal power generation? Empirical evidence from a slacks-based DEA model. *Energy Policy*, 66, 537–546.

Chang P.L. and Wu, C.C. (2007). The study of efficiency and productivity in Taiwan motherboard Industry. *Journal of Information & Optimization Sciences,* 28(6), 945–964.

Charnes, A., Cooper, W. W., and Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2, 429-444.

Cooper, W.W., Seiford L.M., and Tone, K. (2004). Introduction to DEA-Solver-Pro (Professional Version 4.1). DEA-Solver-Pro Newsletter 2004. 8 (5).

Cooper, W. W., Seiford, L. M., & Tone, K. (2007). Data Envelopment Analysis: a Comprehensive Text with Models, Applications, References and DEA-Solver Software. 2nd Edition. Springer Science Business Media.

Duzakin, E. and Duzakin, H. (2007). Measuring the performance of manufacturing firms with super slacks based model of data envelopment analysis: an application of 500 major industrial enterprises in Turkey. *European Journal of Operation Research*, 182, 1412-1432.

Frijns B., Margaritis D., Psillaki M. (2012). Firm efficiency and stock returns. *Journal of Productivity Analysis*, 37, 295-306.

Gandhi, A. and Shankar, R. (2014). Efficiency measurement of Indian retailers using Data Envelopment Analysis. *International Journal of Retail & Distribution Management*, Vol. 42(6), 500-520.

Gaganis, C. Hasan, I. and Pasiouras, F. (2013). Efficiency and stock returns: Evidence from the insurance industry. Discussion Papers. Bank of Finland Research 14.

Gue, H. and Yue, J. (2008). The Relationship between Bank Efficiency and Stock Returns: Evidence from Chinese Listed Banks. *World Journal of Social Sciences*, Vol. 1. No. 4. September 2011, 95-106.

Hadad, M. D. et al. (2008). Banking Efficiency and Stock Market Performance: An Analysis of Listed Indonesian Banks. Discussion Paper Series. Dept Economics Loughborough University, 2008-08.

Ioannidis, C. Molyneux, P., and Pasiouras, F. (2008). The relationship between bank efficiency and stock returns: evidence from Asia and Latin America. Working Paper Series. School of Management Bath University, 2008-10.

Joshi, R.N. and Singh, S.P. (2010). Estimation of total factor productivity in the Indian garment industry. *Journal of Fashion Marketing and Management*, 14(1), 145-160.

Liadaki, A. and Gaganis, C. (2010). Efficiency and stock performance of EU banks: Is there a relationship? *Omega - The International Journal of Management Science*, 38, 254-259.

Liao, H., Holmes, M., Jones, T.W., and Llewellyn, D. (2007). Productivity growth of East Asia economies' manufacturing: A decomposition analysis, *The Journal of Development Studies*, 43(4), 649-674.

Liu, F.-H.F. and Wang, P.-H. (2008), "DEA Malmquist productivity measure: Taiwanese semiconductor companies", *International Journal of Production Economics*, 112, 367-379.

Liu, S.T., (2009). Slacks-Based Measures for Predicting Bank Performance. *Expert Systems with Application*, 36, 2813-2818.

Lozano and Guierrez. (2011). Slacks-based Measure of Efficiency of Airports with Airplanes Delays as Undesirable Outputs. *Computers & Operations Research*, 38, 131–139.

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

Margono, H., Sharma, S.C., Sylwester, K. and Al-Qalawi, U. (2011). Technical Efficiency and Productivity Analysis in Indonesian Provincial Economies. *Applied Economics,* 43, 663-672.

Mojo, Mohamad Ikhsan. (2007). Total Factor Productivity Growth in Indonesian Manufacturing: A Stochastic Frontier Approach, *Global Economic Review: Perspectives on East Asian Economies and Industries*, 36(4), 321-342.

Prabowo, Handono E. T. and Cabanda, Emilyn. (2011). Stochastic Frontier Analysis of Indonesian Firm Efficiency: A Note. *International Journal of Banking and Finance*, 8(2), Article 5.

Selamat, Z. and Nasir, A.Md. (2013). Efficiency Measurement of Malaysian Agriculture Firms. *International Journal of Trade, Economics and Finance*, 4(2), 79-84.

Tone, K. (2001). A Slacks-Based Measure of Efficiency in Data Envelopment Analysis. *European Journal of Operational Research*, 130, 498–509.

Tone, K. (2002). A Slacks-Based Measure of Super-Efficiency in Data Envelopment Analysis. *European Journal of Operational Research*, 143, 32–41.

Vardar, G. (2013). Efficiency and Stock Performance of Banks in Transition Countries: Is There a Relationship? *International Journal of Economics and Financial Issues*, 3(2), 355-369.

Viverita and Ariff, M. (2008). On productivity performance gains of Indonesian firms. *Managerial Finance*, 34(9), 644–659.

Yang, Hsu-Hao. (2010). Efficiency and productivity evidence from international airports in the Asia-Pacific region, *Journal of the Chinese Institute of Industrial Engineers*, 27(2), 157-168.

Zhu, J. (2009). Quantitative Models for Performance Evaluation and Benchmarking: Data Envelopment Analysis with Spreadsheets. 2nd edition. *International Series in Operations Research & Management Science*. Springer Science and Business Media.

Super Slack Efficiency

ORIGINALITY REPORT

19%	15%	13%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.econjournals.com Internet Source	2%
2	www.logforum.net Internet Source	1%
3	deazone.com Internet Source	1%
4	www.scribd.com Internet Source	1%
5	Erkut Düzakın, Hatice Düzakın. "Measuring the performance of manufacturing firms with super slacks based model of data envelopment analysis: An application of 500 major industrial enterprises in Turkey", European Journal of Operational Research, 2007 Publication	1%
6	dspace.lboro.ac.uk Internet Source	1%
7	link.springer.com Internet Source	1%

8	www.mdpi.com Internet Source	1%
9	ccsenet.org Internet Source	<1%
10	eprints.uny.ac.id Internet Source	<1%
11	www.colliers.com Internet Source	<1%
12	George Iatridis. "Terrorist attacks and company financial numbers: Evidence on earnings management and value relevance from Madrid, London and Istanbul", Research in International Business and Finance, 2012 Publication	<1%
13	Aggeliki Liadaki, Chrysovalantis Gaganis. "Efficiency and stock performance of EU banks: Is there a relationship?", Omega, 2010 Publication	<1%
14	ejournal.ukm.my Internet Source	<1%
15	dro.deakin.edu.au Internet Source	<1%
16	www.ijsrp.org Internet Source	<1%
	file.scirp.org	

17	Internet Source	<1%
18	Soetanto, Tessa Vanina, and Liem Pei Fun. "Super Slack-Based Model Efficiency and Stock Performance of Manufacturing Industry Listed in Indonesian Stock Exchange", Procedia - Social and Behavioral Sciences, 2015. Publication	<1%
19	"Data Envelopment Analysis", Springer Nature, 2007 Publication	<1%
20	onlinelibrary.wiley.com Internet Source	<1%
21	Gong-Bing Bi, Wen Song, P. Zhou, Liang Liang. "Does environmental regulation affect energy efficiency in China's thermal power generation? Empirical evidence from a slacks-based DEA model", Energy Policy, 2014 Publication	<1%
22	digilib.iainlangsa.ac.id Internet Source	<1%
23	Azizul Baten. "chapter 2 Kuala Lumpur Stock Exchange Traded Bank Performance with Stochastic Frontiers", IGI Global, 2015 Publication	<1%

www.ibimapublishing.com

24	Internet Source	<1%
25	www.colliers.pl Internet Source	<1%
26	www.academicjournals.org Internet Source	<1%
27	grips.repo.nii.ac.jp Internet Source	<1%
28	www.bmeb-bi.org Internet Source	<1%
29	repository.unissula.ac.id Internet Source	<1%
30	usir.salford.ac.uk Internet Source	<1%
31	U D Kumar, A B Roy, H Saranga, K Singal. "Analysis of hedge fund strategies using slack-based DEA models", Journal of the Operational Research Society, 2017 Publication	<1%
32	Li-Chang HSU. "USING A DECISION-MAKING PROCESS TO EVALUATE EFFICIENCY AND OPERATING PERFORMANCE FOR LISTED SEMICONDUCTOR COMPANIES", Technological and Economic Development of Economy, 2014	<1%

Publication

33	www.coursehero.com Internet Source	<1 %
34	vlc.bath.ac.uk Internet Source	<1 %
35	sibresearch.org Internet Source	<1 %
36	Sueyoshi, T.. "Computational strategy for Russell measure in DEA: Second-order cone programming", European Journal of Operational Research, 20070701 Publication	<1 %
37	Cook, W.D.. "Rank order data in DEA: A general framework", European Journal of Operational Research, 20061016 Publication	<1 %
38	www.tandfonline.com Internet Source	<1 %
39	www.emeraldinsight.com Internet Source	<1 %
40	Rashmi Malhotra. "chapter 38 SIDE", IGI Global, 2018 Publication	<1 %
41	Fadzlan Sufian. "The determinants of efficiency of publicly listed Chinese banks: evidence from	<1 %

two-stage banking models", Macroeconomics and Finance in Emerging Market Economies, 2009
Publication

42	www.inflibnet.ac.in Internet Source	<1%
43	espace.curtin.edu.au Internet Source	<1%
44	fedetd.mis.nsysu.edu.tw Internet Source	<1%
45	etd.lib.metu.edu.tr Internet Source	<1%
46	www.pucsp.br Internet Source	<1%
47	academicjournals.org Internet Source	<1%
48	www.aessweb.com Internet Source	<1%
49	mpra.ub.uni-muenchen.de Internet Source	<1%
50	scholar.lib.vt.edu Internet Source	<1%
51	Giokas, Dimitrios, Nicolaos Eriotis, and Ioannis Dokas. "Efficiency and productivity of the food	<1%

and beverage listed firms in the pre-recession and recessionary periods in Greece", Applied Economics, 2015.
Publication

52	Yasar A. Ozcan. "Health Care Benchmarking and Performance Evaluation", Springer Nature, 2014 Publication	<1%
53	SaEd M. Salhieh, Mira Y. Al-Harris. "New product concept selection: an integrated approach using data envelopment analysis (DEA) and conjoint analysis (CA)", International Journal of Engineering & Technology, 2014 Publication	<1%
54	www.worldscientific.com Internet Source	<1%
55	core.ac.uk Internet Source	<1%
56	Michalis Doumpos, Emilios Galariotis, Giacomo Nocera, Constantin Zopounidis. "Chapter 1 Multiattribute Assessment of the Financial Performance of Non-life Insurance Companies: Empirical Evidence from Europe", Springer Nature, 2018 Publication	<1%
57	Ke Wang. "DEA based multiple criteria evaluation and the cross efficiency method for	<1%

units ranking", 2008 International Conference on Management Science and Engineering 15th Annual Conference Proceedings, 09/2008
Publication

58	Ndari Surjaningsih, Bayu Panji Permono. "THE DYNAMICS OF TOTAL FACTOR PRODUCTIVITY OFMEDIUM AND LARGE MANUFACTURING IN INDONESIA", Buletin Ekonomi Moneter dan Perbankan, 2014 Publication	<1%
59	Abdul Latif Alhassan, Nicholas Biekpe. "Competition and efficiency in the non-life insurance market in South Africa", Journal of Economic Studies, 2016 Publication	<1%
60	International Series in Operations Research & Management Science, 2016. Publication	<1%
61	Benchmarking: An International Journal, Volume 19, Issue 6 (2012-10-27) Publication	<1%

Exclude quotes	On	Exclude matches	< 5 words
Exclude bibliography	On		