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The Business and Management Challenges of the ASEAN Economic Community 2015

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The Business and Management Challenges of the ASEAN Economic Community 2015

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Editors and Contributors

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THE PRODUCTION EFFICIENCY OF SMALL-SCALE INDUSTRY BATIK SEMARANG

Ngatindriatun[1], Hertiana Ikasari[2] and Viverita[3]

Abstract

The production efficiency is an increasingly important determinant of the future of the small-scaled batik industry. This study examined the productive efficiency of a sample of batik producers in Semarang, Central Java by estimating the constant returns to scale (CRS) and variable returns to scale (VRS) output-oriented DEA models. Results of from the two models revealed that the average efficiency of the industry is 71.6 percent and 62.7 percent respectively. These results indicate that there is still room for improvement of the efficiency of batik industry to a better future.

Keywords: Production efficiency, batik industry

JEL Classification: C14

1. Introduction

The failure of economic development system which focus on big-scale industry had made the economic planner to change it on small-scale industry and middle-scale industry (UKM). It proven strong enough when economic crisis happened in 1998 and the next became prime agenda for Indonesia economic development. In 1997, UKM contribution for Product Domestic Bruto (PDB) is 53,6 percent, which is increasing significantly by 18,76 percent from 2006. In addition, during the crisis in 2007 the number of UKM increased dramatically to grow at 99.99 percent each year, while the big-scale industry only grew at 0,01percent (Kompas, 30 May 2008).

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The role of small-scale industry is considerably important in the developing country such as Indonesia, considering its social and economic function (Kuncoro dan Wijayanto, 2001). For example, the small-scale industry absorbed about 99 percent of national labor force (Tambunan, 2001). It also has big contribution for low-income families and employment opportunities, especially in rural areas. Furthermore, small-scale industry is one of a very crucial activator for local commmunity and economic development. It also one of the prime factor stimulus for the development non-oil exports. Besides, small-scale industry is supporting big-scale industry as the producer of components (Tambunan, 2001).

Despite its important role of the small-scale industry, it still faces some obstacles such as capability, skill, expertise, human resources management, entrepreneurship, marketing and finance (Kuncoro, 2008). Of the various obstacles have raised awareness for all people especially government to take sides with UKM. The development paradigm now is more focus on economic empowerment by involving community participation based on spirit of democracy and autonomy in efforts to create equitable. Community participation is the basis of the changes UKM empowerment, whereas the government is as regulator, facilitators, and stimulator.

To carry out these functions, small-scale industries should improve their competitiveness by increasing quality of the product and industry's production efficiency. Small-scale industry has ability to face crisis although competitiveness of Indonesian products is still low. We can see it from macro indicators : level of inflation, level of interest, and export growth. Two main points as a cause of low competitiveness are low efficiency and high-cost economy. Besides that, competitiveness of Indonesian products is still low because the quality, quantity and continuity of supply industrial products are not yet qualified in the world trade.

Batik is known since 17th century, and in 2009 batik has receive recognition from UNESCO as world heritage. This recognition will give added value for batik's industry develoment (Waspada Online, 2008). In addition, batik is one of the main product in Central Java that many managed by small-scale industries (Jawatengah.go.id, 2004). Formerly, Semarang was one of the central of batik business, just like Solo and Pekalongan. It can proven by batik village destination in Semarang. But unfortunately, batik Semarang is now almost extinct. Besides the loss of art and culture, it is also release the opportunity to achieve benefits from batik business (Pemkot Semarang, 2009). Currently, Semarang has 37 batik business, and is spread across several districts in Semarang. However, business condition of batik Semarang has not been touched yet to participate batik business by increasing production and marketing (Desperindag Kota Semarang, 2009).

Based on the pre survey conducted by researchers, in general batik crafters have met difficulties in productivity. These difficulties because lack of labor who have batik skill and lack of fund to open a batik business. There is assumption that we need lot of fund to open batik business. While the existing batik businesses in Semarang is still small business with low level of production outputs, which ended up at high cost industry.

In small firms, all decision executed by the owner. In contrast, big firms have a number of different persons in charged to make different decisions. Like big firms, small firms in batik industry also aim to generate maximum profit. The different between the two is only in a matter of profit distribution. In small firms all the profits are owned by the owner, whereas in big corporations, profits are distributed to the shareholders after the expenditures (Pyndick and Rubinfeld, 2005). However, profit generated by the firms depends upon how efficient they can provide products.

The purpose of a small batik business is to maximize profits. Profits have related with efficiency in production. Inefficient production processes can be caused by technically inefficient production processes. It is because maximum productivity is not achieved, as well as not optimally used input factors. Most of batik crafters orientation is relatively homogen. They use technical efficiency as an effort to maximize productivity. In reality, batik crafters and their industry are not always be able to achieve level of technical efficiency as expected.

According to Mubyarto (2006) efficiency is a condition where resources have been utilized optimally. Based on that statement, there is inefficiency on management of small-scale batik industry in Semarang. So, it is necessary to measure the level of efficiency. From that we would found factors that caused low production levels of small-scale batik industry. The results will be used to determine policies for performance improvement.

Considering the small sample of batik firms available, we employed a non-parametric data envelopment analysis (DEA) to measure the efficiency score of each batik firm in Semarang in 2010. In addition, since DEA can also be used to measure relative efficiency of each firm compare to the most efficient firm in the sample. Therefore, this study is expected to be able give advice to the owner of the small and medium batik firms in using production factors, so they can increase the production efficiency and quality.

This study examined the productive efficiency of a sample of batik producers in Semarang, Central Java by estimating the constant returns to scale (CRS) and variable returns to scale (VRS) output-oriented DEA models. Results of from the two models revealed that the average efficiency of the industry is 71.6 percent and 62.7 percent respectively. These results indicate that there is still room for improvement of the efficiency of batik industry to a better future.

The rest of the paper is organized as follows: Section 2 provides a brief review of the relevant literature, that is, the theory of efficiency on which the current research draws up on. Section 3 presents data and variables used in the study. In section 4, provides the findings of the study. Section 5 concludes the paper.

2. Literature Review on Efficiency

Efficiency performance commonly can be estimated using various methods. A common and widely used method is the financial ratios, such as liquidity, profitability, risk, and asset quality. Ratios provide tools for managing information in order to analyze a firm’s financial condition and performance (Shapiro *et al.* (2000; 36)). These can provide a profile of a firm’s economic characteristics, competitive strategies, operating, financial, and investment decisions relating to other firm or industry (White *et al.* (1998; 41)). However since financial ratios consist of one variable compare to another, it will not give enough information about various dimension of the bank’s performance. Therefore, it fails to consider the multiple inputs used to deliver some outputs in generate performance.

The limitation of financial ratios to accommodate multiple inputs and multiple outputs in measuring performance inspired researcher to use methodology such as economic efficiency. A popular measure of economic efficiency measurement began from early works of Farrel (1957), and is increasingly applied in the 1990s to study performance. He defined a simple measure of firm's efficiency that could deal with multiple inputs, not at a time, but over a period of time. One of the most well-known approaches in measuring firm's efficiency is the *Data Envelopment Analysis* (DEA).

The DEA as a method of measuring efficiency of such an entity (well known as a decision making unit-DMU) is widely used since it was introducing in the earliest work of by Charnes, Cooper, and Rhodes in 1978. They described DEA as a mathematical programming model applied to observational data that provides a new way of obtaining empirical estimates of relations such as the production functions that are using many inputs to produce outputs. This model had an input orientation and assumed that the DMUs are operated at constant returns to scale (Coelli *et al*., 2005). This method involves the derivation of efficiency scores of a set of DMUs relative to one another, involving mathematical programming. In general, the measurement is conducting using sets of inputs and outputs of the DMUs being observed.

Using the DEA methodology, one can calculate the relative efficiency of DMUs, which can be advantage the need for assigning a priori measures of relative importance of to any inputs or outputs. Therefore, one can define efficiency as full efficiency when none of its inputs or outputs can be improved without deteriorating some of its other inputs or outputs. In addition, a DMU can be considered as 100 percent efficient if the performance of other DMUs cannot be improved without worsening some of its other inputs or outputs.
DEA is used as a tool to evaluate operating performance of such a DMU or an organization, where the performance is simply measured as unit (DMU) efficiency or productivity, which is a ratio of output produced to input used in the production processes. For example, partially we can measure labour efficiency as sales per number of employee. In addition, we can also measure total productivity by incorporating all possible inputs used to produce all possible outputs of such entity.

It uses data as inputs and output quantities of a group of firms to construct a piece-wise frontier over the data points. This frontier is constructed by the solution of a sequence of linear programming problems, one for each firm in the sample. Efficiency measures are then calculated relative to this frontier, which represents an efficient technology. Hence, this method is an ideal measure for broad measurement of efficiency. Moreover, "it allows efficiency to be measured without having to specify either the form of production function or the weights for inputs and outputs used".

Charnes *et al.* (1978) first used the DEA constant returns to scale (CRS model) to measure the efficiency of not-for-profit entities in the U.S. public programs. However, where constant returns to scale do not prevail, it can be argued that these units should be compared given their scale of operations. At least, it would be useful to know the extent to which any inefficiency of a unit can be decomposed into its overall (cost) efficiency, technical and its allocative efficiency (Charnes *et al*. (1978; 11)). These methods are now widely used for measuring performance of firms.

The concept of efficiency measure using CCR firstly suggests a return to scale (CRS) model of efficiency. It normally relates to the increasing or decreasing efficiency of such DMU based on size of its outputs. A constant returns to scale means that a DMU able to linearly scale inputs and outputs without increasing or decreasing efficiency. On the other hand, variable returns to scale refers to a situation that the DMU experience increasing (IRS) or decreasing (decreasing returns to scale-DRS) efficiency due to scale variability of inputs and outputs. Charnes, Cooper and DEA can be estimated either as input-oriented or output-oriented index. The DEA input approach defines the frontier by seeking for the maximum possible reduction in input usage, with output held constant, *vice versa*. The two results of both measures give the same technical efficiency scores when constant returns to scale is assumed.

The simple way to explain DEA is in the form of ratio. This means that a DMU would like to measure the ratio of all input used and output produce. Supposed we have the data of A inputs and B outputs for each of I DMUs. For the i-th DMU these are denoted by the vectors u_i and v_i respectively. The A $\times 1$ input matrix and the B$\times 1$ output matrix, while N represents the data of all DMUs. Therefore, to measure the ratio of all outputs over all inputs, we have to obtain the optimal weights using the mathematical programming as follows[4]:

[4] See Coelli, et al., 2005.

$$
\begin{aligned}
&\max_{uv}(u' y_i / v' x_i), \\
\text{st} \quad & u' y_j / v' x_j \le 1, \qquad \text{j=1,2,3,…N.} \qquad (1) \\
& u, v \ge 0
\end{aligned}
$$

The objective function is defined to maximize the ratio of weighted output over weighted input. In addition, the constraint requires that using the same weights, none of the DMUs will have an efficiency score of more than one. However, to overcome the problem of infinite number of solutions and multiplier form, we can use the duality in linear programming that can derive an equivalent envelopment form as[5]:

$$
\begin{aligned}
&\min_{\theta\lambda} \theta, \\
\text{st} \quad & -y_i + Y\lambda \ge 0, \qquad (2) \\
& \theta x_i - X\lambda \ge 0, \\
& \lambda \ge 0
\end{aligned}
$$

It also assumed that we do not know the weights of those input and output variables, but it is a result of the optimalization process. The optimalization process is also done separately for each DMU.

Since the assumption of constant returns to scale (CRS) only can be applied when all the DMUs are operating at an optimal scale, we need to consider factors that make this assumption inappropriate. For example, the effect of DMUs' external conditions such as macro economic condition, imperfect competition, etc. Therefore, we need to modify the CRS linear programming to account for variable returns to scale (VRS) that can be written as:

$$
\begin{aligned}
&\min_{\theta\lambda} \theta, \\
& -y_i + Y\lambda \ge 0, \\
& \theta x_i - X\lambda \ge 0, \\
& NI'\lambda = 1 \\
& \lambda \ge 0
\end{aligned}
$$

where N1 is and Nx1 vector of ones.

[5] θ is a scalar and λ is a Nx1 vector of constant.

In this paper, an output-oriented measure using CRS is assumed because the DMUs want to maximize their outputs using given inputs using production function. DEA measures are obtained by introducing a ratio of M outputs over N inputs. Since efficiency is commonly measured in terms of technical efficiency, therefore, in a simple way, technical efficiency can be written as a simple linear function as follows:

$$\begin{aligned} &\text{Max}_{x,y} && \left(\mathbf{y}'\mathbf{q}_i / \mathbf{x}'\mathbf{p}_i\right) \\ &\text{Subject to} && \mathbf{y}'\mathbf{q}_j / \mathbf{x}'\mathbf{p}_j \leq 1, \quad j = 1, 2, \ldots, I, \\ &&& \mathbf{y}, \mathbf{x} \geq 0 \end{aligned} \tag{3}$$

where **y** represents an $M \times 1$ vector of output weights and **x** represents an $N \times 1$ vector of inputs weights. The $N \times 1$ input matrix, **P,** *and* the $M \times 1$ output matrix, **Q**, represent the data for all I DMUs.

3. Data and Variable specifications

This study used primary data from 18 small batik industry in Semarang, who produced two types of batik, i.e: hand-made batik and stamp batik. The specific data items used in this study are: number of batik produced for each type of batik, raw materials, indirect materials, labors, equipment, kerosene and spacious place of business.

This study employed one output factor and six input factors. Output variable used in this is the number of batik produced during 2010 (in unit), while input factors consist of direct raw materials (in meter); indirect materials, which are auxiliary materials used in the batik process for one month, such as coloring and paraffin (in kg); labor used in the production processes (number of worker); equipments including canting, stove, frying pan, and stamp patterns measured on unit; energy used in the production processes, which is kerosene (in litre); and working space, measured in $m^{2.}$

4. FINDINGS

Table 1 depicts both constant return and variable returns to scale technical efficiency measures, for the batik industry in Semarang. On average, the industry experienced technical inefficiency, where most of the inefficiencies can be traced to inefficient utilization of inputs in producing batik. For example, based on the CRS and VRS efficiency calculation this industry has to increase their output by 28.40 percent and 37.37 percent respectively.

Table 1: Constant Returns to Scale (CRS) and Variable Returns to Scale Technical Efficiency of Batik Industry in Semarang, 2010

No	DMU	CRS Efficiency	VRS Efficiency
1	Batik Aries	0.213	0.217
2	Batik Musa	0.400	0.407
3	Batik Tomo	0.447	0.800
4	Batik Tatik	0.500	0.718
5	Batik Esther	0.500	0.537
6	Batik Tari	0.508	0.010
7	Batik Ambaryani	0.600	0.010
8	Batik Erna	0.602	0.010
9	Batik Rumiyati	0.630	0.010
10	Batik Fega	0.747	0.785
11	Cinta Batik Semarangan	0.756	0.785
12	Batik Semarang 16	0.987	1.000
13	Batik Ana	1.000	1.000
14	Batik Elly	1.000	1.000
15	Batik Endang	1.000	1.000
16	Batik Lilik Lathifah	1.000	1.000
17	Batik Umi Salamah	1.000	1.000
18	Zie Batik	1.000	1.000
Mean		0.716	0.627

The result of efficiency calculation by using Warwick Windows DEA is relative efficiency. It means efficiency value which is resulted by each firm is relative to other firms in the sample. Results in Table 1 also shows that more than 60 percent of the firms are not able to produce more outputs using given available input factors (where the efficiency scores are below 1.000) when computed using the CRS either VRS measures.

Out of eighteen batik firms in the industry, only six firms were operated efficiently using CRS assumption and seven firms are efficient using the VRS assumption. At the opposite, batik Aries, Batik Tari, Batik Ambaryani, Batik Erna and Batik Rumiyati are the least efficient firms in the sample.

Efficiency calculation based on assumption of CRS model shows that there were only 6 or about 33.3 percent of small batik firms were having efficiency value of 1.000 or 100 percent. It means efficient on technical and scale. Those 6 efficient small business batik are Batik Ana, Batik Elly, Batik Endang, Batik Lilik Lathifah, Batik Umi Salamah and Zie Batik. While 12 or other 66.6 percent are inefficient indicated by the efficiency value less than 1.000 or less that 100 percent. In addition, based on VRS model the results show that there are 11 or about 61.1 percent small batik firms having efficiency value of 1.000 or 100 percent, while 7 firms or about 38.8 percent are in efficient.

Based on CRS and VRS model, small business batik Semarang have a lot of waste on input use of raw materials, auxiliary materials, labors, equipment, kerosene, and idle working places. Based on the findings, we suggest that small batik firms should reduce to waste their input in order to be efficient. Besides, make their inefficient business into professional business by a good management.

Considering the weak efficiency of the small batik industry, to improve the performance they need to improve its operating efficiency. For example, by using advanced methods in producing batik.   In addition, there is also a need to have a regular coaching and training from the government or batik association to the workers of batik industry in order to enhance and update their knowledge.

5. CONCLUSION

The production efficiency is an increasingly important determinant of the future of the small-scaled batik industry. This study examined the productive efficiency of a sample of batik producers in Semarang, Central Java by estimating the constant returns to scale (CRS) and variable returns to scale (VRS) output-oriented DEA models.

Relative efficiency based on CRS assumption shows that six out of eighteen or 33.3 percent small batik firms in Semarang were found to be technically and scaleefficient. Twelve out of eighteen or 66.6 percent other small business were inefficient. While based on VRS assumption, there are 11 or 61,1% small business of batik Semarang efficient technically. Seven or other 38,8% is inefficient. Based on CRS and VRS model, small business batik Semarang have a lot of waste on input use of raw materials, auxiliary materials, labors, equipment, kerosene, and area of business premises. The suggestion is Small business batik Semarang on producing batik should reduce waste of input use in order to produce optimally. Besides, make their inefficient business into professional business by a good management.

This study only examines the relative efficiency of relatively small number of batik firms with limited period. To get a robust results, it is suggested that future study may explore the performance of batik industry in Semarang using a longer time period. In addition, it also important to take into account to use other methods in measuring firm's efficiency. For example by measuring productivity change over a significant period, therefore we may know the change of technical efficiency and technological used by the firms. In addition, we may calculate cost efficiency of the industry to investigate how much inputs should be reduced or how much outputs should be produced to be efficient. Furthermore, based on the findings an input oriented approach may be an appropriate model to apply in evaluating the efficiency performance of the industry.

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