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Efficiency Analysis of Private Higher Education in Indonesia Using DEA Approach

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Abstract - *This study measures the relative efficiency level of private higher education in Indonesia between 2017 and 2018. The data was analyzed using the Data Envelopment Analysis (DEA) with the Constant Return to Scale and Variable Return to Scale methods. The input and output variables consisted of the number of lecturers, study programs, and enrolled students graduates, and new entrants, respectively. According to the results, private higher education in Indonesia is not fully efficient. Therefore, future research needs to compare state and private higher education efficiency levels.*

Keywords: *Efficiency; private higher education; data envelopment analysis*

1. INTRODUCTION

In terms of quantity, private universities in Indonesia have increased. The number of private universities in Indonesia keeps increasing. In 2018, higher education units and study programs reached 3293 and 21,154, respectively. However, A total of 3,171 of this proportion were from the private sector under the Ministry of Education and Culture, subject to Higher Education Service Institutions (L2DIKTI) spread throughout Indonesia (Kemdikbud, 2018). A total of 14 L2DIKTI currently oversee 14,429 study programs and 177,140 lecturers in private higher education institutions.

Efficiency measurement in an organizational unit is important because, with a limited budget, changes in the level of efficiency significantly influence the achievement of Sustainable Development Goals (SDG), even with a limited budget. This makes an efficient measurement unit important in an organization (Hsu, 2014)[8]. Similarly, in higher education, efficiency shapes character and human civilization.

Data Envelopment Analysis (DEA) is an efficiency measurement tool introduced and developed by Farrel (1957)[7], Charnes, Cooper, & Rhodes, E. (1978)[4], and Banker, Charnes, & Cooper (1984)[2]. According to Coeli et al. (2005)[5], DEA can easily be used since it is non-parametric and does not require functional specifications, such as population parameters. In the last decade, most higher education efficiency research articles used DEA. For instance, Alabdulmenem (2017)[1] reported that 25 state universities in Saudi Arabia are efficient, though with low resource utilization. According to Cunha and Rocha (2012)[6], 14 universities, 20 polytechnics, and 14 faculties in Portugal are inefficient. Similarly, the efficiency test conducted by Pietrzak, et al., (2016)[14] showed 33 faculties in Poland universities were inefficient. In Germany, 33 institutions are more efficient in technology departments than in applied sciences (Baskaya and Klumpp, 2014)[3]. According to Obadić, A., & Aristovnik, A (2011)[13], tertiary institutions in Slovenia are more efficient than in Croatia. Furthermore, Monfared and Safi (2012)[12] stated that only 16 of 27 universities in Iran were cost-effective. Although many studies have been conducted using DEA, more focus has been on public tertiary institutions. For this reason, this study used two DEA methods, specifically constant return to scale (Charnes e al., 1978)[4] and return to scale variables (Bankers et al., 1984)[2].

2. PURPOSE OF THE STUDY

The research measured private higher education efficiency levels in Indonesia, using the input variable, including the number of study programs and lecturers. The output variable was the number of new entrants, enrolled students, and graduates.

3. RESEARCH QUESTION

1.Are Higher Education Service Institutions (L2DIKTI) in Indonesia efficient?
2.Which Higher Education Service Institutions (L2DIKTI) are efficient?

4. FRAMEWORK OF RESEARCH

Steps conducted to produce a relative level of efficiency included

1.Determining the input and output variables.
2.Data processing with the DEA model using constant return to scale (CSR) and return to scale (VRS) variables.
3.Developing conclusions from tests conducted on the level of efficiency.

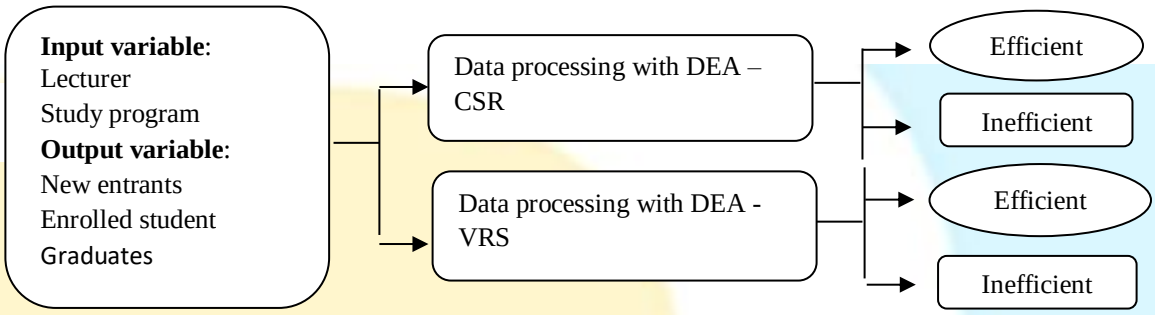

Figure 1: Framework of Research

4.1 Methods

This study used a non-parametric approach from the Data Envelopment Analysis (DEA), which measures efficiency by comparing input and output variables from a Data Organization Unit (Decision Making Unit, DMU). Data was collected from the Ministry of Education and Culture in 2017 and 2018. Input variables included the number of study programs and lecturers, while output had new and enrolled students, as well as graduates (see table 1).
Efficiency testing models used include a constant return to scale (CRS) and variable return to scale (VRS). Charnes, Copper, and Rhodes (1978)[4] stated that in the CSR model, changes in input leads to similar effects in output. The CRS model can be written as follows:
Max θ
Subject to:

$$\sum_{j=1}^{n} xij\ \lambda ij \geq \theta i0 \qquad i = 1,2 \ldots\ldots, m \quad (1)$$

$$\sum_{j=1}^{n} yrj\ \lambda j \geq yi0 \qquad r = 1,2 \ldots\ldots, s \quad (2)$$

$$\sum_{j=1}^{n} \lambda j \geq \theta i0 \qquad j = 1,2 \ldots\ldots, n \quad (3)$$

Where θ DMU is the efficiency, n number of DMU, m number of inputs, s number of outputs xij number of inputs to j DMU j, yrj number of outputs to r DMU j, and λj DMU weight for calculated DMU. Whereas the VRS model assumes that changes in input and output are not the same (Bankers, Charnes, and Cooper, 1984)[2]. Simply, this means that a change in input by x times does not necessarily result in an output increase of the same. The model results added a convexity condition for the weight value λ by including a restriction as shown below.

$$\sum_{j=1}^{n} \lambda j = 1$$

Furthermore, the VRS model can be written into the equation λ max π (DMU efficiency VRS model)
Subject to:

$$\sum_{j=1}^{n} xij\ \lambda ij \geq \pi i0 \qquad i = 1,2 \ldots\ldots, m \quad (4)$$

$$\sum_{j=1}^{n} yrj\ \lambda j \geq yi0 \qquad r = 1,2 \ldots\ldots, s \quad (5)$$

$$\sum_{j=1}^{n} \lambda j \geq 1 \qquad (VRS)$$

$$\sum_{j=1}^{n} \lambda j \geq 0 \qquad j = 1,2, \ldots\ldots, n \quad (6)$$

Where θ DMU is the efficiency, n, and m the number of DMU and inputs, s number of outputs, xij number of inputs to j DMU j, yrj number of outputs to r DMU j, and λj DMU weight for calculated DMU.
The study used predetermined input and output variables from different research works, as shown in Table 1. For instance, the input variables, including lecturers and study programs were developed by (Pietrzak, M, et.al., 2016[14]; Cunha, M., & Rocha, V. 2012[6]; Kantabutra, and Tang 2010[9]; Wolszczak-Derlacz & Parteka, 2011)[15]. The number of students and graduates have been used as output variables in previous studies by (Pietrzak, M, et.al., 2016[14]; Cunha, M., & Rocha, V., 2012[6]; Monfared, S., & Safi, M., 2012[12]; Wolszczak-Derlacz & Parteka, 2011[15]; Kantabutra and Tang, 2010)[9].

Table 1: Input and Output Variables

Variables	Definitions	Input / Output
Study program	The number of study programs in private higher education at L2DIKTI the Ministry of Education and Culture	Input
Lecturer	The number of lecturers in private higher education at L2DIKTI the Ministry of Education and Culture	Input
New entrants	The number of new entrants in private higher education at L2DIKTI the Ministry of Education and Culture	Output
Enrolled students	The enrolled students in private higher education at L2DIKTI the Ministry of Education and Culture	Output
Graduate	The number of graduates in private higher education at L2DIKTI the Ministry of Education and Culture	Output

5. RESULTS AND DISCUSSIONS

5.1 Description Of Input And Output Variables

The descriptive statistical results show that the minimum value of the input variable is in L2DIKTI Region XII of 214 study programs while the highest is in L2DIKTI Region IV of 2,188 units. The highest and lowest lecturer input scores were also in L2DIKTI Region IV and XIV with 28,552 and 2,646 individuals, respectively. According to Table 2, the highest new entrants output variables enrolled students and graduates were in L2DIKTI Region IV with 170,564, 795,042, and 122,163 individuals. Contrastingly, the lowest output of new entrants variable enrolled students was in L2DIKTI Region XII with 7,707 and 44,690 individuals. In comparison, the lowest graduates in L2DIKTI XIV were 5,646 people. Table 2 also shows the average study program input of 1,031 units and 12,653 lecturers. The average variable output of new entrants is 65,812 people, specifically 318,502 enrolled students and 51,678 graduates.

Table 2: Statistic Descriptive of Variable

	Output			Input	
	New Entrants	Enrolled Students	Graduates	Study Program	Lectures
Mean	65.812	318.502	51.678	12.653	1.031
Std Deviasi	50.253	231.979	38.280	8.341	642
Minimum	7.707	44.690	5.646	2.435	214
Maximum	170.564	795.042	122.203	28.552	2.188

Source: own calculation based on universities annual report

5.2 Level Of Efficiency Of Private Higher Education In Indonesia

Based on Table 3, private universities in Indonesia were not efficient in 2017 and 2018. This is because the average value of efficiency after using a constant or variable return to scale was below 1, specifically 0.892 and 0.945 in 2018, and 0.711 and 0.908 in 2017. After testing the efficiency levels in 2018, using the variable return to scale method, L2DIKTI Regions III, IV, VIII, X, XI, XIII, and XIV in charge of private universities had a value of 1. Contrastingly, L2DIKTI Regions I, II, V, VI, VII, IX, and XII were efficient. According to Table 3, L2DIKTI Regions IV, VIII, XIII, and XIV were inefficient in 2018 when tested using the constant return to scale method. Comparably, Regions I, II, III, V, VI, VII, IX, X, and XII were efficient.

Based on DEA testing with CRS in 2017 only 3 private higher institutions in L2DIKTI Region IV, XII, and XIV were efficient. VRS results showed that L2DIKTI Regions III, IV, XI, XII, XIII, and XIV were inefficient. Conclusively, most tertiary institutions were inefficient in 2017 when tested using CRS and VRS.

Table 3: Efficiency Scores

		2018				2017			
No	DMU	CSR	Rank	VRS	Rank	CSR	Rank	VRS	Rank
1.	L2DIKTI region I	0.920	2	0.920	5	0.547	9	0.798	6
2.	L2DIKTI region II	0.773	11	0.774	8	0.480	11	0.691	8
3.	L2DIKTI region III	0.863	7	**1.000**	**1**	0.741	3	**1.000**	**1**
4.	L2DIKTI region IV	**1.000**	**1**	**1.000**	**1**	**1.000**	**1**	**1.000**	**1**
5.	L2DIKTI region V	0.872	4	0.930	4	0.816	2	0.875	3
6.	L2DIKTI region VI	0.918	3	0.934	3	0.658	6	0.905	2

7.	L2DIKTI region VII	0.870	5	0.883	6	0.682	5	0.823	5
8.	L2DIKTI region VIII	**1.000**	**1**	**1.000**	**1**	0.730	4	0.866	**4**
9.	L2DIKTI region IX	0.869	6	0.951	2	0.638	6	**1.000**	**1**
10.	L2DIKTI region X	0.847	8	**1.000**	**1**	0.558	7	0.748	**7**
11.	L2DIKTI region XI	0.772	10	**1.000**	**1**	0.540	10	**1.000**	**1**
12.	L2DIKTI region II	0.788	9	0.833	7	**1.000**	1	**1.000**	**1**
13.	L2DIKTI Region XIII	**1.000**	**1**	**1.000**	**1**	0.566	8	**1.000**	**1**
14.	L2DIKTI region XIV	**1.000**	**1**	**1.000**	**1**	**1.000**	1	**1.000**	**1**
	Mean	0.892		0.945		0.711		0.908	

Source: own calculation based on universities annual report

The results showed that only IV and XIV L2DIKTI regions had similar efficiency levels through the CRS and VRS approaches in 2017 and 2018. VRS calculations with the same efficiencies in 2017 and 2018 include L2DIKTI region III, XI, XIII, and XIV. Seemingly, private higher education institutions in Indonesia are inefficient in 2018 and 2017.

The test results are in line with Cunnha and Rocha (2012)[6], which established that many state universities in Portugal were inefficient. However, this study showed that there were several efficient PHE institutions in the L2DIKTI regions. Alabdumenem, F, M (2017)[1], Pietrzak, et al., (2016)[14], Baskaya and Klumpp (2014)[3], Obadić, A., & Aristovnik, A (2011)[13] and Monfared and Safi (2012)[12] showed similar results.

6. CONCLUSION

This research empirically examined private tertiary institutions' efficiency levels in Indonesia. Data was measured using DEA with two approaches, including CSR and VRS variables. The output variables were new and registered students and graduates. The inputs included the number of lecturers and study programs. According to the test results, private universities in Indonesia are inefficient because index values were less than 1. However, L2DIKTI Regions III, XI, XIII, and XIV were efficient. Therefore, future research needs to compare the efficiency of private and state universities. Additionally, research can be developed by testing efficiency levels through the Malmquist index or total productivity factor.

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