Assessing Local Government Efficiency: Evidence from Sumatra, Indonesia

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Abstract

The purposes of this research were to assess the relative efficiency of local government spending in Sumatra, Indonesia and to analyze the determinants of this efficiency. Data Envelopment Analysis (DEA) and multiple regression were employed for a data set of the spending of 154 local governments in 2016. Three inputs were used to measure the relative efficiency: (i) direct personnel spending per capita, (ii) spending on goods and services per capita, and (iii) capital spending per capita. The two outputs applied were life expectancy and years of schooling. The results show that, of the 154 local governments, 16, across eight provinces in Sumatra, were relatively efficient. Furthermore, population density and per capita gross regional domestic product significantly and positively affected local government efficiency. However, the general purposes grant per capita did not affect local government efficiency. Regional expansion did not cause the

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new split-region governments to be more relatively efficient than the governments of their parent regions.

1. Introduction

Indonesia began to have a decentralized government system when a law on regional government was enacted in 1999. The implementation of this decentralization was accompanied by an increase in the number of regions through the formation of new autonomous regions (provinces and districts/cities). The number of regions in Indonesia has grown rapidly since 2000, with the addition of eight new provinces spread across various islands, so that the total number of provinces in Indonesia is 34. Indonesia consists of five large islands: Sumatra, Java, Kalimantan, Sulawesi, and Papua. The island which experienced the largest expansion was Sumatra, which at the beginning had only 92 districts and cities and today has 154 districts and cities. Thus, Sumatra gained 62 new districts/cities, whereas there were only half as many new districts/cities in the other islands: 36 in Sulawesi, 28 in Papua, 18 in Kalimantan, and only 9 in Java.

In the current regional system, regional governments at the district/city level have full authority to manage their regions, including the regulation of regional income and spending. With the funds available to them, from both local income and transfers from the central and provincial governments, local governments allocate their spending to programs and activities that are beneficial for the welfare of the people in their area. With the largest number of new autonomous regions being in Sumatra, it is necessary to evaluate the efforts of the local governments and their performance in improving the welfare of the people in Sumatra.

In terms of government spending, total regional government spending in Sumatra is the second largest after Java (which is the center of development in Indonesia). Figure 1 shows that government spending in Sumatra is far greater than government spending in Kalimantan, Sulawesi, or Papua. This higher spending is related to the fact that the largest regional expansion is in Sumatra. However, the rapid increase in government spending in Sumatra has not been accompanied by an increase in the quality of human life, measured by such things as life

expectancy. Figure 2 shows a decrease in life expectancy in Sumatra during the period 2009-2014, and this was also the case in Papua.
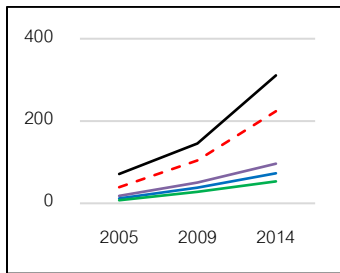

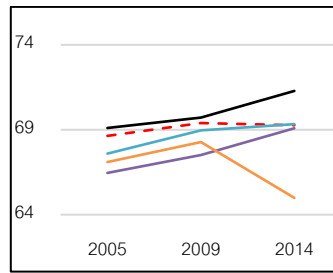Figure 1: Government spending in each Island in Indonesia (trillion rupiahs)

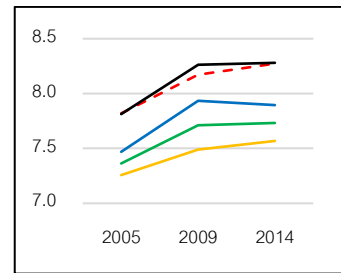Figure 2: Life expectancy in each island in Indonesia (years)

Figure 3: Years of schooling in each island in Indonesia (years)

Note: ---- Sumatra —— Jawa   —— Kalimantan   —— Sulawesi   —— Papua

Source: Ministry of Finance, Indonesia

Source: Indonesia Statistic Bureau

Source: Indonesia Statistic Bureau

Although life expectancy declined steadily, the number of years of schooling in Sumatra continued to increase (Figure 3); this was an indication of inefficiency because most other islands were able to increase their life expectancy and the number of years of schooling simultaneously. For this reason, it is interesting to study how efficient local governments are in their spending. An evaluation needs to be carried out to discover which local governments are relatively efficient in spending their money to improve life expectancy and years of schooling in Sumatra.

It is therefore very important to evaluate the efficiency of governments based on the outputs of activities and programs financed by government spending in Sumatra. Many studies have described the efficiency of government spending on the basis of different outputs. The most widely used outputs in the health sector are immunization (Gupta & Verhoeven, 2001; Herrera & Pang, 2005), infant mortality (Adam, Delis, & Kammas, 2011; Sinimole, 2012), and life expectancy (Adam et al., 2011; González, Cárcaba, & Ventura, 2010; Hsu, 2014). Meanwhile, the outputs generally used in the education sector are literacy (Gupta & Verhoeven, 2001; Rayp & Sijpe, 2007), secondary school registrations (Adam et al., 2011; Rayp & Sijpe, 2007), and primary and secondary school enrollment percentages (Gupta & Verhoeven, 2001).

Although many types of output have been used in previous studies to determine the efficiency of government spending, not all these outputs can be used as the basis for calculating the efficiency of government spending in Indonesia, especially in the Sumatra regions. For the education sector, school duration seems more appropriate for Indonesia, because Indonesia has 12 years of compulsory schooling. The implication is that local governments must allocate money from their budgets for school fees, while the central government helps through its operational funds (known as school operational assistance). Thus, years of schooling is used as one of the outputs in this study, together with life expectancy, which is chosen because of the limitations on the availability of local data in Indonesia.

Having determined the components of the inputs and outputs for measuring the relative efficiency scores of local governments, the next step is to determine the factors that influence the efficiency of local governments. Previous studies have claimed that population density affects government efficiency (Deng, Zhang, Feng, & Wang, 2013; Porcelli, 2014). The reason for this is that how well a government performs in managing public services depends on the population density of the region. The denser the population in an area, the greater the responsibility of the government in the management of public services, and therefore the greater the possibility of failure. Another factor that has been shown to have a significant influence on government efficiency is the gross domestic product (GDP) per capita (Gonzáles et al., 2010; Sinimole, 2012). GDP per capita represents the welfare of a country. A high GDP per capita implies that citizens live comfortably, with high incomes, good education, and extensive knowledge. People in such situations tend to pay attention to government activities; as a result of this control by the people, the government becomes more careful and efficient in managing its activities and programs.

The general purposes grant has also been shown to be a factor influencing government efficiency (Boetti, Piacenza, & Turati, 2012). Provided by the central government, a general-purpose grant greatly assists a local government in funding major government activities, such as infrastructure programs. If this grant is reduced, the ability of the local government to provide public services is also reduced, which in turn decreases its efficiency.

Figures 4 and 5 illustrate the development over time of gross regional domestic product (GRDP) per capita and general purposes grants per capita in each island in Indonesia. Compared to the other four large islands in Indonesia, GRDP per capita is developing rather slowly in Sumatra: in 2014 GRDP per capita in Sumatra was the third-highest, despite Sumatra having the second-

largest figure for government spending. The general-purposes grants per capita in Sumatra also put the region in the second position in Indonesia. As previously explained, there are indications of relative inefficiency in regional government spending in Sumatra compared to the other islands. Figures 4 and 5 show different development conditions for GRDP per capita and general purposes grants per capita; do these two factors have an influence on the level of relative efficiency in local governments in Sumatra? To answer this question, these two variables are used in this study, together with population density.
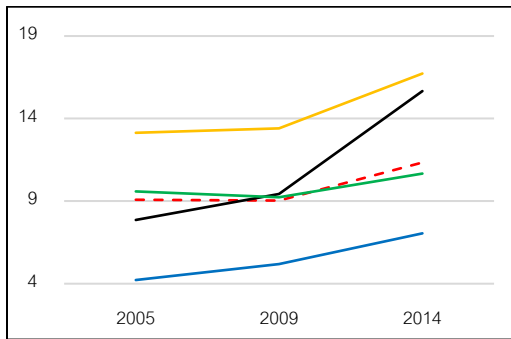

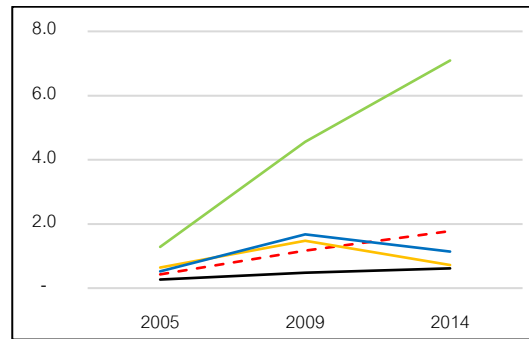Figure 4: GRDP per capita in each Island in Indonesia (million rupiahs)

Figure 5: General-purpose grants per capita in each Island in Indonesia (million rupiahs)

Note: ---- Sumatra — Jawa — Kalimantan — Sulawesi — Papua

Source: Indonesia Statistics Bureau (BPS) and the Ministry of Finance of Indonesia.

The regional expansion was also chosen as a determinant variable for the efficiency of local government expenditure in this study. Although previous studies have found a tendency for government spending efficiency levels to improve in merged regions (Mabuchi, 2001; Moisio & Uusitalo, 2013; Slack & Bird, 2013), Indonesia, which has been splitting regions since 2000, believes that regional splitting is more effective in improving regional welfare.

By splitting the area in which a government has responsibilities, both the parent region and the newly-formed region are smaller, which increases their ability to provide public services, showing that regional splitting can increase government efficiency. Therefore, it is very important to see the impact of the changes in regions on the efficiency of local governments in Indonesia, especially in Sumatra Island, which has the largest number of new districts/cities.

Thus, the purposes of this study are to measure the relative efficiency of local governments and to analyze the effects of GRDP per capita, the general-purposes grant per capita, population

density, and regional splits on the relative efficiency of local government spending in Sumatra, Indonesia. This study is also expected to provide a more advanced perspective on using years of schooling and life expectancy as outputs to calculate the relative efficiency of local governments. Studies on the impact of regional splits on the efficiency of local governments in Asia are relatively sparse and are largely qualitative. There are several studies on the regional expansion in Indonesia, but none of these has covered the effect of these changes on local government efficiency. For example, Booth (2011) explained the regional expansion in Indonesia as a reaction to the inequality and injustice felt by Indonesian people outside Java, which created a perceived need for autonomy for local governments outside Java so that development in these regions could be carried out.

Another piece of research on Indonesia was conducted by Pepinsky and Wihardja (2011), who studied the effect of decentralization only on economic performance in Indonesia, concluding that the implementation of decentralization was unsuccessful. Research on the efficiency of local governments in Indonesia and, more importantly, in Sumatra, is unprecedented. Therefore, this research will provide new insights into how to improve the relative efficiency of local governments in the regions of Sumatra Island.

This paper is organized as follows. It begins with the background, with the phenomena and the reasons why this research is important being outlined. There is then a review of the relevant literature. After that come the methods and the data used for this study. In the discussion session, the research results and data processing are illustrated, and there is a discussion of the research results. This paper ends with concluding remarks.

2. Conceptual framework

2.1. Government efficiency

The most common input variable in measuring government efficiency is government spending. One of the proxies commonly used to measure government efficiency is spending per capita (Afonso & Fernandes, 2008; Gupta & Verhoeven, 2001; Hsu, 2014; Rayp & Sijpe, 2007; Sinimole, 2012; Yusfany, 2015). Meanwhile, both Geys and Moesen (2009) and Boetti et al. (2012) employed total current spending as the proxy for government spending, while Davis and Hayes (1993) used operational spending and capital spending as inputs.

Another proxy for government spending that is used as an input for measuring relative efficiency is government spending per category. Several researchers have inspected government

spending in certain sectors. Sinimole (2012) used total health spending as input. Hsu (2014) only used health spending per capita. González et al. (2010), and also Gupta and Verhoeven (2001), employed education and health spending per capita as inputs. Meanwhile, Adam et al. (2011) used, as their proxy, government spending in six sectors (education, health, economic affairs, public services, welfare, and social security).

For the outputs used in measuring efficiency, there is a difference between the proxies used to measure the efficiency of corporations and those used to measure the efficiency of governments. The outputs of corporations are generally more quantifiable, as corporations are profit-oriented. However, since public organizations are not oriented toward profit, they aim to improve the economic and social welfare of the general public. In turn, in the public sector, the output used for efficiency measurements tends to be broader than the output used for corporations. The efficiency of local government spending can be interpreted as the efforts of the local government to optimize costs in their attempts to improve the economy and public welfare.

The output used in local government efficiency studies is, therefore, a variable that represents the quality of public welfare. For the education sector, several outputs are commonly used as government efficiency indicators, namely the literacy rate (Gupta & Verhoeven, 2001; Rayp & Sijpe, 2007), the number of students in primary school (Geys & Moesen, 2009), middle school enlistment (Adam et al., 2011; Rayp & Sijpe, 2007), and the primary and secondary school enlistment percentages (Gupta & Verhoeven, 2001). The number of years of schooling is also inspected as an output in measuring efficiency (Dufrechou, 2016; Herrera & Pang, 2005).

Finally, for the health sector, many researchers have used life expectancy for measuring government efficiency (Adam et al., 2011; Afonso & Aubyn, 2005; Gonzáles et al., 2010; Gupta & Verhoeven, 2001; Herrera & Pang, 2005; Hsu, 2014). The infant mortality rate is also commonly used as an output in measuring government efficiency in the health sector (Adam et al., 2011; Rayp & Sijpe, 2007; Sinimole, 2012), while for the standard of living, GDP per capita is used as an output in measuring government efficiency (Adam et al., 2011).

2.2. Factors affecting government efficiency

Population density has been found to be a determinant of government efficiency. Various researchers have found that population density damages government efficiency (Boetti et al., 2012; Geys & Moesen, 2009; Porcelli, 2014). By contrast, other studies have revealed that population

density has positive effects on government efficiency (Deng et al., 2013; Yusfany, 2015). A few studies have found that there is no significant effect of population density at all (Afonso & Fernandes, 2008).

In Indonesia, there are several components of government spending related to health and education, the amount of which is adjusted according to the population. The higher the population, the higher the population density, and thus the higher the government spending. Therefore, because there is higher government spending in areas with a high population density, regional governments in such areas are expected to work relatively more efficiently.

Hypothesis 1: Population density has a positive effect on the relative efficiency of the local government.

The gross domestic product also influences the rate of government efficiency. A number of researchers have found that gross domestic product (GDP) per capita positively affects government efficiency (Deng et al., 2013; De Oliveira, 2012; Dufrechou, 2016; Gupta & Verhoeven, 2001). GDP has also been found to have a positive effect on government efficiency (Gonzáles et al., 2010; Sinimole, 2012), although Agasisti (2014) and Yusfany (2015) found a negative effect of GDP on government efficiency. However, the majority of previous studies have shown a positive effect of GRDP on government efficiency. Therefore, this research proposes that there is also a positive impact of GRDP on local government relative efficiency.

Hypothesis 2: Gross regional domestic product per capita has a positive effect on the relative efficiency of the local government.

General-purposes grants also determine government efficiency. Previous research shows that general purposes grants negatively affect government efficiency (Boetti et al., 2012). Similarly, Balaguer-Coll and Prior (2009) found a negative influence of general-purposes grants per capita on government efficiency. However, Geys and Moesen (2009) found a positive impact of general purposes grants on government efficiency. In Indonesia, a general purposes grant is defined as a transfer from the central government to the local government to support local government funds. However, there is no restriction on spending allocations from these grants – local government is

free to allocate them to management costs (such as paying employees) or to programs and activities for the community, so local governments do not have to work hard to set up programs and activities aimed at improving the welfare of the community. For this reason, the hypothesis of this research will follow the results of Balaguer-Coll and Prior (2009).

Hypothesis 3: General purposes grants per capita have a negative effect on the relative efficiency of the local government.

The impact of regional splits on local government efficiency is also tested in this research. Booth (2011) concluded that regional splitting in Indonesia caused a decrease in the number of citizens served by each government in a region, but unfortunately, this was followed by a decrease in the government's technical and administrative capacity (such as facilities and government personnel). In this way, it became rather difficult to fulfill the needs of the people, proving that regional splitting harms public services. This argument was supported by Fitrani, Hotman, and Kaiser (2005), who also researched regional splitting in Indonesia. Years after the regional splitting occurred, it was found that the quality of welfare had decreased since the regional splitting occurred, where the indicators used for welfare were the society's spending per capita, the poverty rate, and the education rate. Because the previous studies in Indonesia have shown poorer results since regional splitting took place, this research uses a dummy variable for whether or not the local government is a new region resulting from a regional split, and thus aims to discover whether new local governments resulting from regional splits have less relative efficiency, on average.

Hypothesis 4: The new local government efficiency resulting from regional splits is, on average, lower than that of parent regions or regions where there has been no split.

2.3. Efficiency measurement

Data Envelopment Analysis (DEA) has various advantages. First, in DEA a functional correlation between output and input is not required (Deng et al., 2013; Nannyonjo & Okot, 2013; Zhang & Garvey, 2008). The DEA calculates a relative ratio by comparing the total value of multiple outputs and the total value of multiple inputs for each unit without requiring a functional correlation between the outputs and the inputs (Bogetoft & Otto, 2011; Hsu, Luo, & Chao, 2008; Ray, 2004).

The second advantage is that DEA is capable of measuring the efficiency of multiple outputs to multiple inputs (Bogetoft & Otto, 2011; Gonzáles et al., 2010; Hsu, 2014; Huguenin, 2012; Nannyonjo & Okot, 2013). Furthermore, DEA is capable of benchmarking relative performance between one corporation and another (Bogetoft & Otto, 2011; Cooper, Seiford, & Tone, 2002; Huguenin, 2012, p. 6). DEA can identify sources of inefficiency and the number of inefficient inputs (or outputs) in each unit, meaning that DEA is capable of determining which input to decrease or which output to increase in order to reach the best efficiency level. Moreover, DEA can identify sources of decision-making unit (DMU) inefficiencies based on the orientation of the input or output applied (Coelli, Rao, O'Donnell, & Battese, 2005; Huguenin, 2012).

Indonesia is a developing country; state funding is limited, and providing for public services that increase life expectancy and years of schooling (the two outputs for this research) is not an easy task. Local governments are expected to manage their funds efficiently. Therefore, it is necessary to know how government spending should be used to achieve optimum social welfare. This can be discovered using an output-oriented method, and thus this will be the method employed by this research.

3. Methods and data

Sumatra consists of ten provinces. Within each province, there are several districts and cities, and the provincial government coordinates the activities of the districts and cities in the province. In the current era of decentralization and regional changes, districts and cities have become the spearheads for regional development organizers. Therefore, the unit of analysis in this study is the government at the district level, looking at the 154 districts and cities in Sumatra in 2016. The data in this study were obtained from the Indonesian Statistical Center (BPS) and the Indonesia Financial Audit Agency (BPK RI).

DEA is a nonparametric method for measuring the efficiency of units such as corporations or public sector agencies (Ray, 2004). On the basis of the relationship between the input and the output scales, a DEA efficiency measurement can be conducted using various approaches. These approaches are the constant return to scale (CRS) model, also known as the CCR model (after Charnes, Cooper, and Rhodes), and the variable return to scale (VRS) model, also known as the BCC model (after Banker, Charnes, and Cooper). In the CRS model, there is an assumption to be

proven: that each DMU will operate on a constant return to scale (CRS), in which changes at the input level result in proportional changes at the output level (Coelli et al., 2005).

In the second approach, the VRS model assumes that each DMU does not operate at an optimal scale and that the ratio of an input increase to an output increase is not always the same: if there is an increase in input by *n* times, the output will not increase by *n* times, and, instead, may increase by more or less than *n* times. There is another assumption in the VRS model, which is that the production scale affects efficiency and productivity. Technology is one of the factors in the VRS model; this opens the possibility that the scale of production might affect efficiency. As explained in the first part of this article, several of the provinces have undergone regional splitting, so that the return to scale for each province has varied, either increasing or decreasing. From this argument, it is reasonable to use the VRS approach in this research.

Based on the VRS approach and the output-oriented method, the relative efficiency model for this research is as follows:

Objective function

$$Max\ E = \mu_1 Y_1 + \mu_2 Y_2 + \mu_0 \qquad \text{.......................................} (1)$$

Subject to

$$\vartheta_1 X_1 + \vartheta_2 X_2 + \vartheta_3 X_3 = 1 \qquad \text{.......................................} (2)$$

$$\mu_1 Y_1 + \mu_2 Y_2 - (\vartheta_1 Y_1 + \vartheta_2 Y_2 + \vartheta_3 Y_3) \leq 0 \text{..............} (3)$$

$$\mu_{1,2} \geq 0 \qquad \text{...} (4)$$

$$\vartheta_{1,2,3} \geq 0 \qquad \text{…...} (5)$$

where Y_1 = life expectancy; Y_2 = years of schooling; X_1 = direct personnel spending per capita; X_2 = spending on goods and services per capita; X_3 = capital spending per capita; E = efficiency score of DMU (local government); $\mu_{1,2}$= values for outputs Y_1, Y_2; $\vartheta_{1,2,3}$ = values for inputs X_1, X_2, X_3; and μ_0 = intercept, which can take either a positive or a negative value.

From the efficiency model, it can be seen which local government is efficient and which is not. Furthermore, looking at the efficient local governments, it can be seen which of them is a peer for inefficient local governments. This benchmarking is one of the advantages of using DEA. Bogetoft and Otto (2011) and Cooper et al. (2002) define benchmarking as a system of comparing the performance of one company with that of other companies. In other words, DEA makes comparisons between analytical units that change the same type of input into the same type of

output. From this benchmarking, DEA explicitly identifies the peer units for each unit evaluated. In the output-oriented method, a peer unit is a relatively efficient analysis unit that has the same type and number of inputs but is able to produce the largest amount of the same type of output. This study will identify units that are peers for relatively inefficient local governments.

After finding the score for the relative efficiency of each local government and identifying peer units, the next step is to analyze the four factors that are hypothesized to affect the local government relative efficiency. The method of analysis used is multiple regression. The method used in the regression model is ordinary least squares (OLS). The level of significance in this study is 5%. The regression model applied is:

$$E = \alpha + \beta_1 D_{RS} + \beta_2 \ GRDP \ per \ cap - \beta_3 \ GG \ per \ cap + \beta_4 \ PD + \epsilon \quad .. (6)$$

where E = relative efficiency score; D_{RS} = dummy variable of regional split (D = 1 means split; D = 0 means other); PD = population density; GRDP per cap = Gross Regional Domestic Product per capita; and GG per cap = general-purposes grants per capita.

4. Results and discussion

4.1. Local government efficiency

The efficiency scores in DEA lie in the range of 0–1, with 1 being efficient. The information regarding local government efficiency with an input-oriented model in Sumatra Island, Indonesia can be seen in Table 1.

Out of the 154 local governments that are treated here as DMUs, only a small number are relatively efficient (with E = 1): there are 16 relatively efficient local governments (10.39% of the total). These 16 relatively efficient local governments are located within eight provinces. Of these eight provinces, most of the relatively efficient local governments are based in North Sumatra and Lampung provinces (four relatively efficient local governments each). The local governments in these two provinces are better at managing direct personnel spending per capita, spending on goods and services per capita, and capital spending per capita to achieve high life expectancy and years of schooling.

Table 1: Relative efficiency level of local government in Sumatra, Indonesia

No	Provinces	Number of local governments	Mean	Lowest local governments	Lowest E	Highest local governments	Highest E	E > Mean Total	%
1	NAD	23	0.927	Subussalam	0.863	Banda Aceh	1.00	10	43.47
2	North Sumatra	33	0.938	Mandailing Natal	0.842	Deli Serdang, Langkat, Samosir, Medan	1.00	15	45.45
3	West Sumatra	19	0.951	Mentawai Islands	0.874	Bukit Tinggi, Padang, Padang Panjang	1.00	12	68.42
4	South Sumatra	17	0.924	Empat Lawang	0.876	OKU Timur	1.00	4	17.64
5	Riau	12	0.951	Meranti Islands	0913	Pekan Baru	0.998	9	75.0
6	Riau Island	7	0.924	Lingga	0.821	Batam	1.00	4	57.14
7	Jambi	11	0.954	East Tanjung Jabung	0.893	Muaro Jambi	1.00	6	63.63
8	Bengkulu	10	0.915	Lebong	0,849	Bengkulu city	1.00	1	10
9	Bangka Belitung	7	0.957	South Bangka	0.913	Pangkal Pinang	0.988	6	85.71
10	Lampung	15	0.951	West Pesisir	0.850	South Lampung, Central Lampung, East Lampung, Bandar Lampung	1.00	11	73.33

Note: Mean in the 4rd column refers to mean of local government in every province.

The small number of a relatively efficient local governments in each province shows that most local governments in Sumatra do not perform efficiently. This is proved by the average relative efficiency score of 0.939. This score shows that there is an average level of inefficiency of 6.1% for spending by local governments in Sumatra. The local government with the lowest relative efficiency score (E= 0.821) is Lingga (in the province of Riau Islands). Thus, the greatest relative inefficiency occurs in Lingga, reaching 17.9%.

Next, the relative efficiency conditions based on the respective provinces are described. Evaluated by the average of the relative efficiency among the local governments in each province, the mean efficiency ranges from 0.915 (local governments in Bengkulu province) to 0.957 (local governments in Bangka Belitung province). This means that the average level of local government inefficiency in Bengkulu province is the highest, at 8.5%. By contrast, the average level of

inefficiency of local government in Bangka Belitung province is the lowest in Sumatra, at only 4.3%. Meanwhile, all the local governments in two provinces (Riau and Bangka Belitung) are found to be relatively inefficient.

Furthermore, it can be seen that local governments in Bangka Belitung province have the highest mean in Sumatra even though there is no relatively efficient local government in this province. This is the result of almost all local governments in this province achieving a higher level of efficiency (although they are still not relatively efficient) than other districts/city governments in Sumatra. This can be seen from the fact that the majority of local governments in Bangka Belitung Province (six out of the seven local governments, or 85.71%) achieved efficiency above the average efficiency in Sumatra (0.939). Table 1 also shows the number of local governments in each province that, although relatively inefficient, score higher than the average efficiency score (0.939). Of the 154 local governments, there are 78 local governments with above-average efficiency scores (51%). Thus, there are 76 local governments (49%) with an efficiency score between 0.821 and 0.939. In other words, there is significant inefficiency, specifically between 6.1% and 17.9%, in almost half of the local governments in Sumatra.

The level of inefficiency of using the three inputs to achieve the outputs (life expectancy and years of schooling) indicates that local governments have not been able to allocate their spending to programs and activities that support the improvement of life expectancy and increase the years of schooling. Various programs carried out by these local governments do not directly help to achieve good outputs. Too much spending is lost, while satisfactory outputs are not obtained.

After the analysis of the relative efficiency scores, further analysis is carried out into how the 138 relatively inefficient local governments could improve their efficiency. One of the many advantages of DEA is that it offers information on benchmarking for inefficient governments. Relatively inefficient local governments are encouraged to set, as a benchmark, one or several relatively efficient local governments with similarity in inputs and outputs. These relatively efficient local governments then become peers for the inefficient local governments.

However, not all relatively efficient local governments are capable of acting as peers to relatively inefficient local governments. Out of the 16 relatively efficient local governments, only 11 become peers. This indicates that only these 11 relatively efficient local governments share similarities with the inefficient local governments and can be used by the 138 inefficient local

governments for benchmarking to improve their efficiency. In this research, several inefficient local governments are not similar to 11 peers. For this reason, each inefficient local government can carry out benchmarking against several peers. The relatively efficient local government which acts as a peer to most inefficient local governments is Padang city (in the province of West Sumatra). Thus, 130 inefficient local governments can carry out benchmarking to Padang city government. Meanwhile, the ten other relatively efficient local governments acting as peers are Bukit Tinggi (104 inefficient local governments), Deli Serdang (28), Bandar Lampung (7), East Lampung (4), Medan (3), Samosir (2), Banda Aceh (2), Padang Panjang (1), Central Lampung (1), and East OKU (1).

The next step is to show the relationship between local government spending and relative efficiency scores. This information can be seen in Figure 6, which shows the ability of certain local governments to reach efficiency despite low or inadequate government spending.
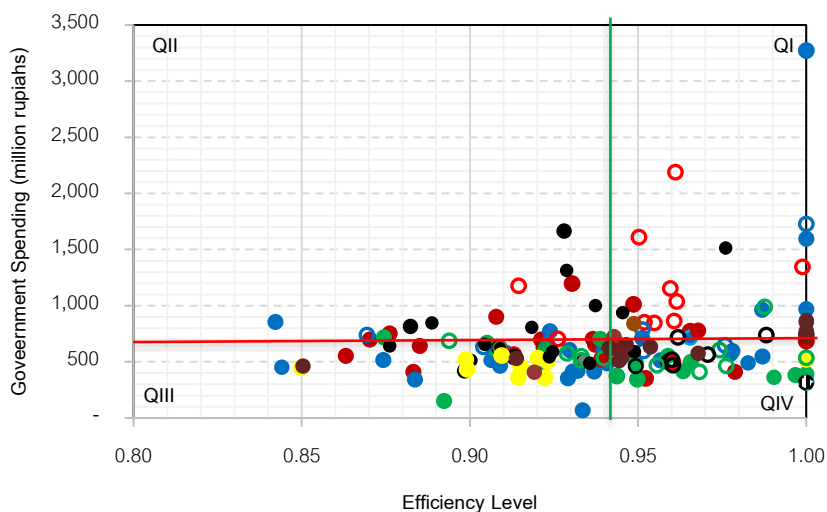

Figure 6: Efficiency score and government spending relationship in Sumatra, Indonesia

Note: ● is NAD;   ● is North Sumatra; ● is West Sumatra;   ● is South Sumatra;   ;   ● is Bengkulu;

○ is Riau;   ○ is Riau Island;   ○ is Jambi;   ○ is Bangka Bellitung;   ● is Lampung

——— is average of government spending

——— is average of efficiency level

Figure 6, divided into four quadrants, explains the position of local governments based on total government spending and the relative efficiency rate. The best position is in quadrant IV, in which the local government's spending is below average and yet its efficiency is above average.

This is considered as the best position because local governments in this quadrant allocate less spending than others but still obtain a high level of efficiency. This indicates that these local governments have programs and activities in the health and education sector that are better than others so that they are able to achieve a high level of efficiency. From Figure 6, the 16 efficient local governments are categorized into quadrant I and quadrant IV. Out of these 16 (see Figure 1), only two efficient local governments (Bukit Tinggi city and Padang Panjang city) have government spending that is higher than average (quadrant I). Meanwhile, the other 14 efficient local governments are in quadrant IV.

In addition, in quadrant IV there are also local governments that are not yet relatively efficient but have a higher than average level of efficiency. Considering the number of local governments in each province in quadrant IV, it turns out that the province with the highest number of local governments in quadrant IV is West Sumatra (13 local governments), followed by North Sumatra (6 local governments). On the other hand, the worst position is in quadrant II, in which the local government efficiency is below average and government spending is above average. In quadrant II, there are no local governments from Bengkulu or Bangka Belitung provinces. The provinces with the highest number of local governments in quadrant II are South Sumatra and NAD provinces.

4.2 Factors affecting local government efficiency: results from the regression model

After determining the efficiency score of each local government, the next step is to analyze the factors affecting these scores. A classic assumption test is conducted to test whether the research data has issues with normality (Jarque–Bera test), linearity (Ramsey test), heteroscedasticity (BPG test), and multicollinearity (VIF). From the tests, these classic assumptions are fulfilled, and therefore the analysis can proceed by testing the hypotheses.

Based on the F test, with $\alpha = 5\%$, and knowing that the probability is 0.001, the null hypothesis (H0) is rejected. This implies that all four independent variables significantly affect the relative efficiency of local governments. Meanwhile, the determinant coefficient R^2 in the regression model shows that these four independent variables are capable of explaining only 30.45% of the varying fluctuation of the efficiency value of local governments. To proceed, the hypothesis test is completed with an information test and regression model, as shown in Table 2.

Table 2: Regression results

Constant	dummy	Ln GRDP per cap	Ln General-purpose grants per cap	Population Density
0.866660	-0.006219	0.022481	-0.017256	0.00001
(0.038824)	(0.010395)	(0.010539)	(0.011166)	(0.00005)
***		**		**

R^2 = 0.304531

F stat = 5.911366

Prob = 0.000509

Note: the standard errors are in parentheses below the estimates. ***, **, and * indicate significance at 1%, 5%, and 10%, respectively

A t-test is then performed to test the variables individually. For the first variable, population density, the probability is below 5%, so H0 is rejected. Thus, population density positively and significantly influences local government efficiency. In other words, districts or cities that are more densely populated are able to spend more efficiently. This finding is supported by the research of Deng et al. (2013) and Yusfany (2015), although it is in contrast with other studies by Geys and Moesen (2009), Boetti et al. (2012), and Porcelli (2014), all of which found negative effects of population density on local government efficiency.

The notion that the population density is a positive determinant of local government efficiency in Sumatra can be explained as follows. Population density varies for each local government; the results show that a denser city or municipality can achieve higher efficiency. This is because, in a larger territory (less dense), the number of public services provided by the local government to improve its output can be utilized by a lower number of citizens. Assuming that the funds for public services are relatively similar regardless of population density, an area with lower density would perform better for a smaller number of citizens with regard, for example, to spending on programs for public schools and hospitals. The funds required for construction and operational costs are fairly similar for buildings of similar size, even if the numbers of users of these public services are very different. This shows why local governments with higher density achieve higher efficiency as well.

In addition, in the use of government expenditure, there is a component of the funds that can be used for public services for a greater number of people. Even with an increase in the

population of an area, meaning a denser population, the funds used will remain the same. This results in relatively more efficient use of funds in denser regions. One example of this is that the number of civil servants tends to be similar among regions despite differences in population density. With the same number of civil servants but different numbers of people for whom the services are provided, the number of civil servants may, of course, become excessive. The number of civil servants in a government is related to the amount of spending; the higher the number of civil servants, the higher the government spending. Because of the similarity in the numbers of civil servants despite the variations in density, local governments with low population densities will waste their spending.

The number of civil servants needed by local governments will decrease in the future because some services that are currently performed manually will be done in the future by machines and through information technology. With the use of technology, local governments can provide public services for a bigger or denser population in their area. An example of the use of technology is the purchase of medical devices. Medical devices can operate for a certain capacity. In sparsely populated areas, the use of these medical devices is not optimal. Conversely, if medical devices are used in densely populated areas, the use of these medical devices will be more efficient.

On the basis of this explanation, this study implies that the local governments should strive to reduce government spending. An example would be for local governments with a low population density to reduce direct personnel spending per capita. The number of civil servants in a region should not increase if the population density in the region does not increase. If the number of civil servants increases even though the population density level remains the same, then the efficiency level of the local government will decrease.

The condition of districts/cities in Sumatra is similar to the condition of regions studied by Yusfany (2015) and Deng et al. (2013). Yusfany examined the efficiency of local governments in six regions in Indonesia in five fields (education, health, public works, housing, and residential areas, and the economy). Using a Tobit regression model, Yusfany concluded that, in Indonesia, a relatively efficient region is a densely populated region.

Likewise, Deng et al.'s research was conducted for three areas of public services (education, public health, and forestry and water utilities) at the county government level in Chongqing municipality, China. By using a Tobit regression model, the research showed that

population density positively influences government efficiency. Deng et al. (2013) explained that there are economies of scale in public service provision by governments at the county level. A higher population density and size will help spread the fixed costs of supplying public services, leading to a reduction in public service costs.

By looking at the conditions in the study area both in this study and in previous research, it can be seen that there are variations in population density between regions. Under these conditions, population density has a positive effect on government efficiency.

The next variable to be tested is GRDP per capita. For GRDP per capita, H0 is rejected at α= 5%, meaning that GRDP per capita has a significant positive effect on the relative efficiency of local governments. This result is supported by prior studies by Deng et al. (2013), De Oliveira (2012), and Gupta and Verhoeven (2001). The effect of GRDP per capita can be explained as follows. Areas with high GRDP per capita are also areas with higher income groups. It can, therefore, be said that in high-income communities, the efficiency of local government is also higher, and, vice versa, in areas with low-income groups, the efficiency of local government is lower. This occurs in Sumatra because, in regions with higher income, people also have higher outputs (years of schooling and life expectancy). In these regions, medical devices and schools support these outputs (years of schooling and life expectancy) better than the medical devices and schools available in lower-income areas.

High-income citizens pay more taxes, as well. In the era of decentralization, local governments have the authority to find their own sources of funds as local revenue. Among the biggest components of local revenues are hotel and restaurant taxes, entertainment taxes, and parking taxes. Higher local revenues result in higher local government spending, increasing the government's capacity to provide infrastructure and public services. However, not all of these public services, for example, hospital facilities and health laboratories, are free. People with high incomes are able to use these facilities when they need them. The provision of infrastructure, school operational spending, and health infrastructure as a result of increased regional income will therefore also increase the efficiency of local government.

Besides, citizens in an area with high income will have higher expectations of their local government. On average, citizens with higher incomes have a higher rate of education and knowledge than poor citizens. With higher education and knowledge comes a higher expectation of the performance of their government. The citizens' demands thus increase as well. This motivates

the government to perform better, to meet the demands and expectations of its people. The more financially well-off citizens are the main contributors to tax – a huge source of income for local governments. From the perspective of the taxpayer, citizens tend to supervise the cash flow of their local government. Does government spending align with the planned programs? Do these programs and events significantly improve welfare? These questions, along with the supervision which generates them, motivate the government to perform more efficiently. The contrary applies to citizens with lower GRDP. When people have a low income, their focus is almost entirely on the urgent need to make ends meet. Because of this, they generally have lower awareness of their government's performance. With little to no criticism and supervision, the government continues to perform moderately and inefficiently.

Under these conditions, this research implies that local governments should create a climate conducive to business so that the business world can continue to develop. The local government should make regulations that support the development of the economy. Besides, local governments should help the growth and development of entrepreneurs and small and medium-sized businesses to continue to increase people's income. The development of the business world is believed to increase people's income, which, in turn, will help the government work more efficiently.

This explanation of how GRDP per capita can improve local government efficiency is almost similar to that given in the research by Deng et al. (2013). Deng et al. explained that in a county in Chongqing (China) with a high economic development level, there are more financial and human resources for public services, which improves the system of public services and the technical conditions, thus contributing to improving government efficiency. Similarly, De Oliveira (2012) examined the effect of GDP per capita on government efficiency in education and health in 208 countries. Using multiple regression analysis, De Oliveira (2012) concluded that richer countries display higher government efficiency.

As for the general-purposes grants per capita variable, H0 is not rejected. The negative impact of general-purposes grants per capita on local government efficiency is not significant. This result differs from the research of Balaguer-Coll and Prior (2009), who argued that general grants negatively affect government efficiency. General purposes grants, although they have a negative effect, do not significantly affect local government efficiency in Indonesia for the following reasons. Local governments, generally, are not able to run entirely on their own funding, because of their

lack of funding sources. General grants from the central government thus become a huge source of income for local governments. The majority of programs and events held by local governments are funded by general grants. The amount of the general grant transferred by the government to each region in a province is almost the same, but the allocation of expenditure by each local government differs. This results in differences in efficiency levels to achieve a specified output. This is the reason why general grants have a negative influence on the efficiency of local government, even though this influence is not significant.

Meanwhile, the research conducted by Balaguer-Coll and Prior (2009) showed that grants per capita had a significantly negative influence on local government efficiency. This research was conducted in Spanish municipalities with a Tobit censored regression method. This research explains that local authorities with a high capacity for obtaining resources (through tax revenue and/or grants) would be less motivated to manage those resources well. The conditions in Sumatra are very similar, although in Sumatra the negative influence of general purposes grants per capita on local government efficiency is not significant.

The last variable is regional splitting, where H0 is not rejected at α = 5%. This means that there is no significant difference in the level of local government efficiency between split regions and regions that have not been split and/or are parent regions. Local governments in split regions do not have lower efficiency than regions that are not split and/or parent regions. Several reasons for this result will be explained. In Sumatra, none of the split region local governments are efficient, while all the efficient local governments are not in split regions. There is no split local government that manages to be efficient. This is because the splitting is rather recent. Even though regional splitting has been going on since 2000, the years in which each of these autonomous regions was established are different. Some of them were founded almost 20 years ago, but some only seven years ago. Most governments are still in the phase of building infrastructure and improving the personnel skills which will be needed to improve welfare, not just in the education and health sectors examined in this study. Besides, local government employees are also still learning how to carry out district/city governance well, by 'learning by doing'. These local governments, therefore, need more time to reach relative efficiency.

This research implies that the central government should not provide an opportunity for a region to split if there is not adequate basic and supporting infrastructure to achieve years of

schooling and life expectancy. The lack of adequate infrastructure in a split area causes the local government to have a low-efficiency level.

5. Conclusion

Using DEA with an output-oriented model, this research finds that among the 154 local governments in Sumatra Island, Indonesia, there are only 16 that manage to achieve relative efficiency in their spending. The remaining 138 local governments have a low relative efficiency score. From this result, a huge improvement in the performance of relatively inefficient local governments is urged, to improve their relative efficiency. One of the ways to increase relative efficiency is for the local government to follow the steps taken by each of its peers. Out of the 16 relatively efficient local governments, there are 11 that can act as peers to inefficient local governments. Furthermore, by using a regression model, it is found that population density and GRDP per capita have a significantly positive effect on local government relative efficiency, while the general-purposes grant per capita has no significant negative effect on local government relative efficiency. The same applies to regional splitting, which is found to have no significant effect on local government efficiency.

In this research, an efficiency calculation using DEA shows that there are several local governments that are relatively efficient in utilizing input (three types of per capita government spending) to produce output (years of schooling and life expectancy). Because this research uses different outputs from other research, especially years of schooling (which is still seldom used as an output for measuring efficiency), the findings of efficiency and its determinants cannot be generalized to other regions.

Other than that, the information on how the local governments manage their programs and activity relatively efficiently is not discussed in this research. This information is crucial as it will give inefficient local governments insights into how to follow the steps taken by their peers to reach efficiency. Therefore, an examination of how efficient local governments manage their program activity to result in the maximum output should be encouraged.

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