

12-31-2020

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Recommended Citation

Fahmi, Mutiara (2020) "The Impact of Disparity in Infrastructure Development on Aceh's Economic Performance: An Inter-Provincial Analysis," *Economics and Finance in Indonesia*: Vol. 66: No. 2, Article 5. DOI: 10.47291/efi.v66i2.674
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The Impact of Disparity in Infrastructure Development on Aceh's Economic Performance: An Inter-Provincial Analysis

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Manuscript Received: 27 March 2020; Revised: 7 August 2020; Accepted: 18 August 2020

Abstract

This study provides empirical findings on regional disparity in infrastructural facilities in 23 districts/municipalities of Aceh Province and the impact of the disparity on the economic performance of Aceh Province, specifically on those of economic growth, poverty, and unemployment. The unit of analysis is the district level and the Infrastructure Development Index (IDI) is used as the variable computed by using the multivariate method. Regional disparity is measured by the Coefficient of Variation and the impact of IDI on the province's economy is analyzed using the econometric model. The analysis shows that infrastructure development disparity exists and that IDI generally affects the economic performance in Aceh Province. Specifically, the results reveal that electricity provision, the number of hotels, and the length of road positively correlate with economic performance. However, the number of Base Transceiver Stations, the number of markets, and the number of banks do not necessarily lead to higher economic performance. The policy implications of the findings are discussed.

Keywords: economic growth; infrastructure development index; poverty; unemployment

JEL classifications: O180; O4; R1

1. Introduction

Infrastructure is the basic aspect of development for any country (Patra & Acharya 2011). The role of infrastructure development has been well recognized in many countries as the foundation of economic growth, as studied by Aschauer (1980), Sahoo & Dash (2009), and Sembanyang (2011). The relationship between infrastructure and regional development is one of the most intricate problems in regional policy, especially for the less prosperous areas such as rural areas (Nijkamp 1986). Improvement in infrastructure services is essential for enhancing the effectiveness of the productive process and raising productivity of any economic entity (Patra & Acharya 2011). Concerning the economic growth, the availability of infrastruc-

ture supports the economy by providing more new jobs for unemployment, ultimately lowering the unemployment rate (Muslikhah 2008; Maryaningsih, Hermansyah & Savitri 2014; Prasetyo & Firdaus 2009) and increasing the productivity level and per capita income, ultimately lowering the poverty level and highly affecting the welfare in the region (Iqbal 2017; Maryaningsih, Hermansyah & Savitri 2014; Démurger 2001).

In general, the central or regional governments have the priority to support economic growth through infrastructure development. However, equal development is vital for every sector to reduce the inequality in the economic growth, for instance, the development of vital facilities such as road, electricity, and public transportations for mobility and access. Those facilities and services are the main engine for the long-lasting economic growth (Cahyono & Kaluge 2012; Iqbal 2017). Therefore,

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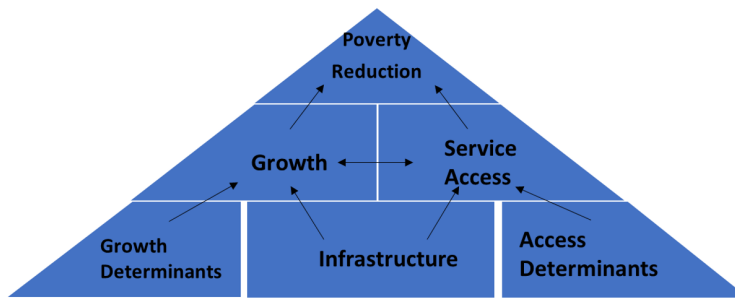


Figure 1. The Link Between Infrastructure, Growth, and Poverty Reduction

Source: IBRD & ADB (2005) in Muljono et al. (2010)

development is not only needed by big cities, but also by villages, to ensure that equal growth can be obtained by all people in the whole country. As a simple illustration, the availability of access to physical infrastructure such as roads will facilitate product distribution and benefit both producers and consumers.

In reality, the economic growth of Aceh Province is still below 5%, which is lower than the national growth. It becomes the third-lowest growth among other provinces in Sumatera Island (BPS-Statistics Indonesia 2019a). Furthermore, Aceh's poverty rate is nearly two times higher than the poverty rate at the national level, even though it slowly decreases recently. Poverty is, in fact, still a vital issue in this province, as well as unemployment, the rate of which is still above 5% in comparison with the national level that is below 5%.

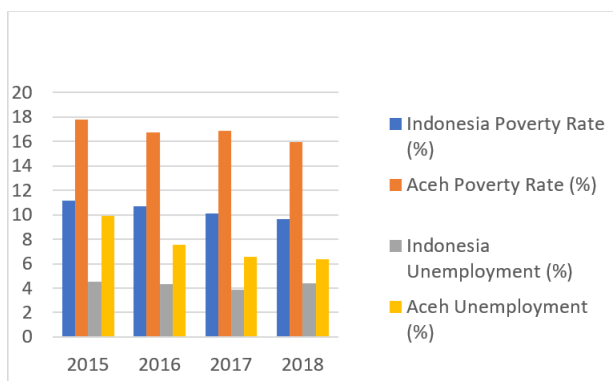


Figure 2. Unemployment and Poverty Rate in Aceh Province and National Levels

Source: BPS-Statistics Indonesia, various series and years

More funding has been allocated by Aceh's government to create a sustainable infrastructure for every region. In detail, Aceh's government expenditure is increasing each year as shown in Table 1. A portion of this funding is allocated to the development of infrastructure. Based on Aceh's Long-term Development Plan (RPJP) for 2005–2025, the infrastructure sector is the second priority of Aceh's development. However, the level of poverty remains high and the economic growth of this province remains below that of other provinces in Sumatera and even below that of national level.

Table 1. The Amount of Special Funding and the Government Expenditure of Aceh Province (in Trillion IDR)

Year	Special Autonomy Fund	Government Expenditure
2015	7,057	6,505
2016	7,707	6,091
2017	7,971	6,667
2018	8,029	8,384
2019	8,357	10,491

Source: BPS Aceh Province Office (*Aceh dalam Angka*), various years

Another noticeable issue in this province is disparity. Many studies observe that Indonesia is a country with a relatively low standard of infrastructure. According to the International Institute for Management Development (IMD 2014), Indonesia is ranked 37th out of 59 countries in terms of low standard of infrastructure. Indonesia-wide, Aceh is one of the less developed provinces in Indonesia, as reported by the National Development Planning Agency (Bappenas) in 2017. Furthermore, this province occupies the 22nd position of 34 provinces

in Indonesia in terms of development.

There have been ample of studies conducted on the relationship between infrastructure and economic growth. However, there has no specific study employing various types of infrastructure with reference to Indonesia and Aceh Province in particular. The disparity in infrastructural facilities remains the main issue to be scrutinized by the Aceh's Government. It can influence many aspects including social and economic aspects (Katamso et al. 2018). It is highly possible for Aceh to encounter the worst problem supposing the government taking no direct action. Based on the aforementioned, the following problems can be formulated: Are there any regional disparities in infrastructural facilities in 23 districts/municipalities in Aceh Province? How can the development of infrastructure affect the GDP, poverty, and unemployment across the province?

This research attempts to answer those questions by analyzing the disparity in infrastructural facilities in 23 districts/municipalities in Aceh Province in Indonesia and the impact of such disparity on economic growth, poverty, and unemployment. The next section discusses the literature review as well as the theoretical framework talking about infrastructure development, economic growth, and regional disparity. Section 3 addresses the data and methodology. Section 4 provides the result and discussion, followed by conclusion and policy implication in section 5.

2. Literature Review

2.1. Infrastructure Development

Infrastructure is the main requirement for other economic sectors to grow. In many developing countries, physical infrastructure is likely to alter economic activities, thus benefitting the economy. Therefore, infrastructure development must have a direct impact or indirect impact on economic growth. According to Warsilan & Noor (2015), infrastructure has a substantial impact on poverty reduction as well as economic growth. Furthermore, infrastruc-

ture is considered to be a significant part of economic development for any levels (Abiad, Debuque-Gonzales & Sy 2017). Thus, infrastructure is not only a crucial part of economic development for low-income countries, but also for upper-income countries.

Infrastructure development is one of the most vital aspects of a country's pursuit of economic growth. Adequate infrastructure may promote efficiency by improving the mobility of goods and services as well as increase economic added value and support regional productivity. Thus, physical infrastructure plays a substantial role in economic growth and acts as an endowment to increase productivity in many sectors (Démurger 2001).

Generally, there are two kinds of infrastructure, namely social infrastructure, and economic infrastructure. According to the World Bank (1994), infrastructure is a set of structures that joins one another and composes a single frame that supports a given structure. For example, transport infrastructure includes railroads, highways, airports, ports, and other elements still associated with transportation. Public utility property includes power generation, telecommunication, air supply pipe, sanitation/waste disposal, and piped gas. Infrastructure is divided into three categories by the World Bank (1994) as follows:

1. Economic infrastructure, i.e. a physical infrastructure needed to support economic activities, including public utilities, public works (roads, dams, canals, irrigation, and drainage), and the transportation sector (roads, railways, ports, airports).
2. Social infrastructure, including education, health, housing, and recreation.
3. Administrative infrastructure, including law enforcement, administrative control, and coordination.

Patra & Acharya (2011) uses Infrastructure Development Index (IDI) to measure regional disparity in infrastructure development in India by using interstate data analysis. This study draws the context of

Indonesia, particularly in Aceh Province, and conduct inter-provincial data analysis. More specifically, IDI is used to analyze regional disparity in infrastructure in all 23 districts and municipalities in Aceh Province. Infrastructure index may differ in each country, depending on the most potential facilities and services available. For instance, a study conducted in 2018 by the African Development Bank (AfDB) in Africa computes different components and indicators and uses them to analyze the progress and status of infrastructure development in those countries. However, both aspects, physical and non-physical indicators, are still included in the components. In this case, Africa obtains AIDI (Africa Infrastructure Development Index) as reported in the AfDB Statistics Department (AfDB 2018). Another study conducted by Donaubauer, Meyer & Nunnenkamp (2016) computes the global Index of Infrastructure and rank of each sector, particularly the economic infrastructure, by combining the data from several relevant sources. The finding of this study is used to estimate the probability gap in infrastructure development in several developing countries.

Many studies state that there is a positive correlation between infrastructure and economic growth. According to Ghosh & De (1998), physical infrastructure such as railways, irrigation, and telephone density plays a significant role in the improvement of many vital sectors in India. Furthermore, physical infrastructure is essential to household life as well as to economic activity. In addition, Ahmad, Ali & Babar (2016) finds a direct connection between infrastructure development and employment opportunity for the youth labor force and an indirect connection between infrastructure development and an improvement in economic growth in the productive sectors.

Mitra, Varoudakis & Végazonès (1998) reveals that infrastructure development is capable of being the main booster for industrial mobility and productivity. A research conducted by Sibarani (2002) in Indonesia discovers that physical infrastructure such as electricity and education significantly af-

fects income per capita. The most crucial issue for Indonesia today is maximizing infrastructure development massively, which is the main concern for the current government. However, the complex problems faced by the country, such as social issues, can be a thick barrier for development.

Infrastructure development and regulatory reform will, therefore, continue to be the priority of the development in Indonesia in 2019–2023. Schwab & Sala-i-Martin (2014) reported that Indonesia faces crucial obstacles in achieving economic growth, one of which is in terms of the infrastructure sector. Most of the state budget is allocated to the infrastructure sector in many regions in Indonesia, including Aceh. Infrastructure will assist all economic activities in the province, such as improving industrial production capacity. Therefore, an increase in production capacity will eventually affect the growth in the region.

Moreover, sustainability will also be obtained in the social sectors supposing the people having better access to essential services and employment. UNCTAD (2010) reported the broad impact of infrastructure development, such as raising productivity, encouraging connectivity, and lowering costs. Furthermore, it increases the diversification of production, trade development, equitable development, poverty alleviation, and quality of life. Thus, infrastructure is vital to promote economic growth and will continually reduce inequality in the country (Srinivasu & Rao 2013).

It may be true that infrastructure, whether physical or non-physical, has a linkage with economic growth. It can also be considerably complicated since it has a direct impact on the consumption and creates many indirect externalities, as suggested by Ghosh & De (2004). A study conducted by Cutanda & Paricio (1993) provides another empirical evidence, in which the infrastructure such as roads, water, and energy supply has a positive impact on growth, especially for the private sector.

2.2. Regional Disparity

Disparity or inequality is different from poverty, yet related. Disparity covers all variations of the standards of living in a whole population, incorporating all aspects among the population (McKay 2002). Generally, disparity is a global issue for any country and the main obstacle for economic growth. On the other hand, regional disparity or inequalities among regions exist due to the concentration of development and other aspects of economic activities (Zali et al. 2013). There are two main sources of regional disparity, namely economic plan and decision of policymakers as well as the condition of natural resources.

Inequality is not a new issue in Aceh Province. The stakeholders and the government still attempt to find the root of the problem. Hadi (2014) reports the fluctuating and high coefficient of inequality in economic development in Aceh Province. McKay (2002) reports that inequality is evident in various aspects of development, one of which is in infrastructure development. Furthermore, disparity does not only occur in social aspects, but also in other aspects such as financial and infrastructure.

Iqbal (2017) uses Scalogram Index and Williamson Index to analyze the effect of infrastructure on the disparity in economic development in Aceh. The results show that there are several indicators that cause a disparity in economic growth, namely health facilities, electricity, and the availability of schools. In detail, Sjafrizal (2008) explains several factors that determine inequality between regions, namely: the difference in natural resources, the difference in demographic conditions, the substandard mobility of goods and services, the concentration of regional economic activities, and the allocation of development funds between regions.

The unequal level of standards mobility may represent the infrastructure and services development. It is true that the economy of Aceh shows continuous growth, supported by the development project of the government. However, the lack of management in allocating special funds can strengthen the issue

of inequality in this province. To make it worse, the development is only concentrated in some particular areas or infrastructure. This particular condition is also the main factor that causes the high level of poverty, leading this province to be one of the provinces with the highest percentage of people living below the poverty line.

Gini index is one of the simplest ways to identify the level of inequality in a country. Figure 3 shows the inequality across districts and municipalities in Aceh. The Gini index for Aceh Province in 2018 is 0.32 and the level of disparity in the city is higher than that in the village (BPS-Statistics Indonesia 2019b). BPS-Statistics Indonesia further reports that the safe level of inequality is below 0.30 for the provincial level. It means that Aceh Province still faces inequality in terms of economic growth and development.

In terms of infrastructure development, the level of disparity remains high. Supposing a country or region having a high Gini Index ratio, it means the level of inequality among the people is notably clear and will reduce the ability of the country to grow in the long run. Regional disparity is likely to happen due to the unequal level of growth, for instance, when the growth of population is more significant than the economic growth (Aidar & Syahputra 2015). In detail, the level of economic growth is closely linked to the standard of available infrastructure and services in the regions. The rapid growth of population in a country has to be balanced with the availability of infrastructural facilities to sustain the growth for sustainable level of income to be achieved.

2.3. Economic Growth

Economic growth is a process that strengthens the standard level of national income and output. Eventually, the growth is expected to assist in improving the economy of a country (Iqbal 2017). Furthermore, positive economic growth is a requirement for people to reach a better standard of life. However, growth cannot be the only goal of in-

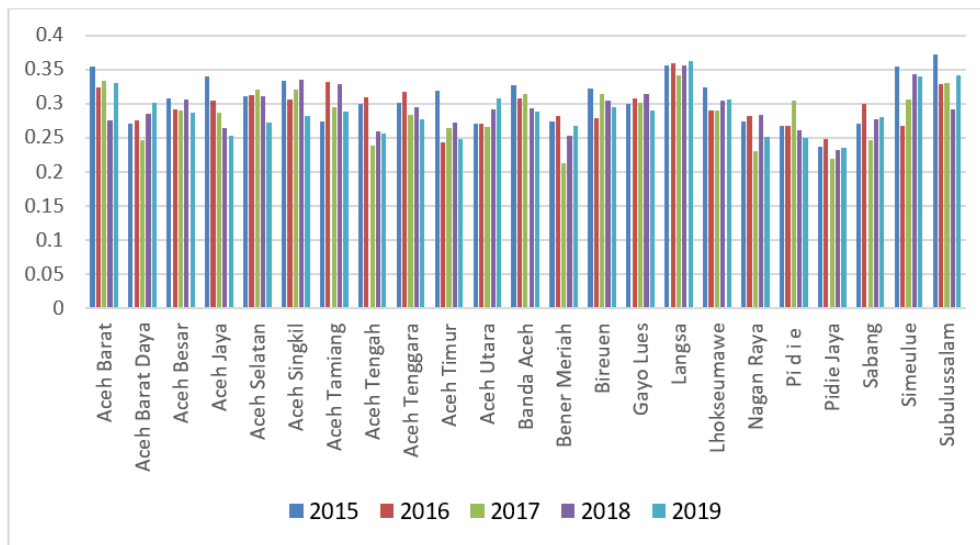


Figure 3. Gini Index in Aceh Province

Source: BPS Aceh Province Office (Development of Gini Ratio by Districts/Municipalities 2015–2019)

infrastructure development in the country because it can also lead to inequality in the social aspects (Sukwika 2018).

Sustainable development is one of the factors that can lead to equality, and the imbalance of the development will lead to inequality in economic growth (Chotia & Rao 2017). Sustainable development as the main goal to achieve better growth is frequently obstructed by the unequal level of development. For instance, Indonesia is a country whose development is only concentrated on Java Island where the capital city is located. This fact may have a negative impact on the sustainability of the whole country, particularly infrastructure development that can support economic activities and increase productivity.

Patunru & Tarsidin (2012) addresses the economic issues in Indonesia and includes the country as the first economic failure among other underdeveloped countries in 1966 due to the hyperinflation and total deficit experienced in that period. This condition was known as the worst crisis in the country and totally affected the growth of several sectors in the regions. It was followed by the rise of inequality level in the early of 2000s.

As for Aceh Province, BPS-Statistics Indonesia (2019a) reveals that Aceh's economic growth is below 5% or the third-lowest among nine other provinces on Sumatera Island. It is also far below the national growth of 5.07%. This condition may be one of the most obvious evidence that inequality does exist in the province. By considering this evidence, and observing it from a policy perspective, a greater emphasis is required in order to achieve high sustainability of economic growth (Sahoo & Dash 2009). Increasing the investment in the sector of infrastructure may be the best possible way to support the long-term economic growth.

3. Method

3.1. Conceptual Framework

Proper and sustainable infrastructure development is essential to support a region. However, in terms of economic development, the acceleration may be the most neglected issue. The pace of the development and the progress of the growth may vary in every region. Some cities may focus on infrastructure while others focus on the people and other economic activities. Furthermore, a big differ-

ence in resources can also be included as the main factors for every region to develop. As the result, some regions may lag in terms of development and need to improve to be able to reach the level of economic growth of developed regions.

Disparity in economy is caused by an unequal accumulation of wealth. Social inequality exists because of lack of wealth in certain areas hindering these people from obtaining the same level of housing and health care. On the other hand, in economic development, disparity is caused by various factors such as unequal level of development, infrastructure, or facilities, which in turn affects the economic growth in the regions. In detail, differences in the availability of infrastructure between regions result in differences in the rate of economic growth, and thus the uneven distributed economic growth causes the imbalance of regional economic development. The channel from which disparity in infrastructure development and the impact of infrastructure index in Aceh Province may affect the GDP/capita, unemployment rate, and poverty rate is illustrated in Figure 4.

3.2. Data Processing and Analysis

3.2.1. IDI and the Formation of the Infrastructural Index

One of the ways to examine regional disparity in economic development is by forming the index. The infrastructure index may differ for each country depending on its core economic activities. For example, Africa has its own Infrastructure Index known as AIDI to monitor the status and progress of infrastructure development across the continent (AFDB 2018). The procedure is proposed by Morris & Liser (1977), as cited in Patra & Acharya (2011). The IDI of districts/municipalities varies from zero to one and the values are chosen in this study as the tools to ensure that a large variety of indicators will not dominate the contribution of the rest infrastructure indicators and distort the inter-provincial comparison (Patra & Acharya 2011). The detailed methodology is as follows:

First, X_{ij} will represent the value of the i^{th} infrastructure development indicator in j^{th} districts/municipalities, ($i = 1, 2, 3, \dots, 9$; $j = 1, 2, 3, \dots, 23$). The basic formula for the model is:

$$Y_{ij} = \frac{X_{ij} - \text{Min}_j X_{ij}}{\text{Max}_j X_{ij} - \text{Min}_j X_{ij}} \quad (1)$$

where $\text{Min}_j X_{ij}$ and $\text{Max}_j X_{ij}$ are the minimum and maximum of X_{ij} respectively. On the other hand, if X_{ij} is negatively associated with the status of infrastructure development, it is written as:

$$Y_{ij} = \frac{\text{Max}_j X_{ij} - X_{ij}}{\text{Max}_j X_{ij} - \text{Min}_j X_{ij}} \quad (2)$$

The scale value of Y_{ij} varies from 0 to 1. Observed from the scale value of the matrix, $Y = \{(Y_{ij})\}$, the construction of the infrastructure development index of different regions is:

$$Y_j = W_1 Y_{1j} + W_2 Y_{2j} + W_3 Y_{3j} + \dots + W_m Y_{mj} \quad (3)$$

where the value of W_i varies inversely as the variation in the respective indicator of infrastructure services is subject to the following condition:

$0 < W_1 < 1$ and $W_1 + W_2 + W_3 + \dots + W_m = 1$ in which

$$W_1 = \frac{K}{\sqrt{\text{Variance} Y_1}} \quad (4)$$

where,

$$K = \left[\sum_{t=1}^m \frac{1}{\sqrt{\text{Variance} Y_t}} \right]^{-1} \quad (5)$$

Overall, the infrastructure development index of the districts/municipalities varies from zero to one.

Hadi (2014) calculates inequality using Aceh's GRDP data and discovers that the coefficients increase each year. Therefore, coefficient of variation was then used to explain the regional disparity in the IDI for each year in the 2015–2019 period.

Path regression analysis was conducted to observe the correlation between 3 dependent variables and IDI. On this regard, all dependent variables were

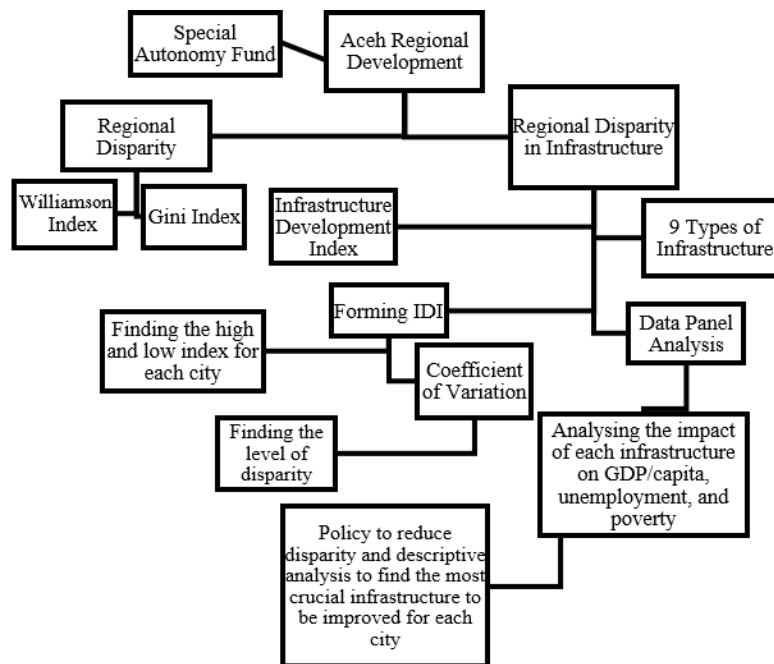


Figure 4. Conceptual Framework

used to define the correlation with each indicator of infrastructure. Table 2 provides the definitions of each variable.

$$\begin{aligned}
 Pov_{it} = & \beta_0 + \beta_1 pve_{it} + \beta_2 pcone_{it} + \beta_3 rlt_{it} \\
 & + \beta_4 htl_{it} + \beta_5 vcrl_{it} + \beta_6 ppl_{it} \\
 & + \beta_7 banpl_{it} + \beta_8 mobil_{it} + \beta_9 psar_{it} \\
 & + \beta_{10} unemp_{it} + \varepsilon_{it} \quad (6)
 \end{aligned}$$

$$\begin{aligned}
 Unemp_{it} = & \beta_0 + \beta_1 pve_{it} + \beta_2 pcone_{it} + \beta_3 rlt_{it} \\
 & + \beta_4 htl_{it} + \beta_5 vcrl_{it} + \beta_6 ppl_{it} \\
 & + \beta_7 banpl_{it} + \beta_8 mobil_{it} + \beta_9 psar_{it} \\
 & + \beta_{10} pov_{it} + \varepsilon_{it} \quad (7)
 \end{aligned}$$

$$\begin{aligned}
 RGDPPC_{it} = & \beta_0 + \beta_1 pve_{it} + \beta_2 pcone_{it} + \beta_3 rlt_{it} \\
 & + \beta_4 htl_{it} + \beta_5 vcrl_{it} + \beta_6 ppl_{it} \\
 & + \beta_7 banpl_{it} + \beta_8 mobil_{it} + \beta_9 psar_{it} \\
 & + \beta_{10} pov_{it} + \varepsilon_{it} \quad (8)
 \end{aligned}$$

3.3. Data Source

Table 3 shows the secondary data source used in this research. The required data were collected from various sources such as Statistics of Aceh Province, including PODES (2015–2019), *Aceh dalam Angka* (2015–2019) and the Audit Board Agency (BPK) of Aceh Province.

4. Results

4.1. Regional Disparity in Infrastructure Development

This first step is examining the infrastructure development in each district/municipality in Aceh Province using IDI. Based on the values of IDI, this study measures the level of infrastructure disparity (regional disparity of infrastructure development) between regions by referring to the Coefficient of Variation for each year measured.

Table 4 shows the changes in IDI for 23 districts/municipalities in Aceh Province during 2015–

Table 2. The Definition of Variables

No	Variables	Definition
Dependent		
1	POV	The percentage of people living under the poverty line
2	UNEMP	The percentage of unemployment to total labor force
3	RGDPPC	Regional gross domestic product per capita at constant prices
Independent		
1	PVE	The number of villages with electricity in 2015–2019 in 23 districts or municipalities
2	PCONE	Total electricity consumed by villagers in each region
3	RLT	The length of provincial road (in kilometers) for each district
4	HTL	The number of hotels (accommodations) available in each city
5	VCRL	Total width of road divided by the total number of villages
6	BANPL	The number of available (operating) banks in each city/municipality
7	MOBL	Base Transceiver Station for cellular communication signals
8	PSAR	The number of available traditional markets in each region

Note: One component of IDI, the available service provider of communication or mailing (usually represented by the number of post offices) is dropped from estimation because its role has been largely replaced by internet services.

Table 3. Sources of Data

No	Variables	Measurement	Source
Dependent			
1	Poverty (POV)	%	BPS-Statistics Indonesia Aceh Province Office
2	Unemployment (UNEM)	%	BPS-Statistics Indonesia Aceh Province Office
3	Regional growth domestic product per capita (RGDPPC)	%	BPS-Statistics Indonesia Aceh Province Office
Independent			
1	Villages electrified	units	<i>Aceh dalam Angka</i> (BPS-Statistics Indonesia Aceh Province Office)
2	Consumption of electricity	%	<i>Aceh dalam Angka</i> (BPS-Statistics Indonesia Aceh Province Office)
3	Length of road	Km	<i>Aceh dalam Angka</i> (BPS-Statistics Indonesia Aceh Province Office)
4	The availability of hotels (accommodations)	units	BPS-Statistics Indonesia Aceh Province Office
5	The percentage of villages connected by road	per sq. km.	<i>Aceh dalam Angka</i> (BPS-Statistics Indonesia Aceh Province Office)
6	The number of Financial Institutions	units	Bank Indonesia
7	The number of mobile consumers (BTS)	units	<i>Aceh dalam Angka</i> (BPS-Statistics Indonesia Aceh Province Office)
8	The number of (traditional) markets	units	Aceh's Mid-term Development Plan (RPJMA), PODES

2019. The distribution value of the index varies from 0 to 1. The closer the index value to zero, the lower the inequality. Otherwise, the closer the index value to one, the higher the inequality in the region in terms of infrastructure development.

Based on the data computation, the index value for every period measured for districts/municipalities is obtained. Overall, the average five-year index slightly increases before dropping in the last year period measured. Furthermore, most districts/municipalities have a high value of index that slightly increases until the last years. Table 4 also shows some variations among these districts in terms of regional infrastructure development. We may divide the regions based on the value of IDI into

two groups, namely: (i) developed regions and (ii) disadvantaged regions. On this regard, developed regions mean that the regions are well-developed in respects to the availability of infrastructure.

The developed regions have higher value of IDI than the average of total (IDI > 0.597) while the disadvantaged or less-developed regions have a lower value of IDI than the average of total (IDI < 0.597), as presented in Table 5. In detail, Aceh Besar, Banda Aceh, and Simelue are the districts/municipalities with the highest score of IDI in all periods, marking them as the most developed districts/municipalities in terms of infrastructural facilities. On the other hand, Langsa, Gayo Lues, and Aceh Barat Daya have the lowest index, mean-

Table 4. Infrastructure Development Index of Districts/Municipalities in Aceh Province

No	Districts/Municipalities	Infrastructure Development Index				
		2015	2016	2017	2018	2019
1	Aceh Barat	0.652	0.704	0.687	0.704	0.708
2	Aceh Barat Daya	0.376	0.354	0.374	0.388	0.375
3	Aceh Besar	0.745	0.746	0.752	0.793	0.757
4	Aceh Jaya	0.656	0.591	0.608	0.664	0.603
5	Aceh Selatan	0.610	0.575	0.594	0.642	0.598
6	Aceh Singkil	0.559	0.612	0.680	0.616	0.601
7	Aceh Tamiang	0.668	0.662	0.672	0.695	0.678
8	Aceh Tengah	0.478	0.512	0.507	0.540	0.530
9	Aceh Tenggara	0.602	0.581	0.588	0.634	0.611
10	Aceh Timur	0.663	0.655	0.656	0.703	0.674
11	Aceh Utara	0.700	0.696	0.686	0.746	0.703
12	Bener Meriah	0.628	0.672	0.676	0.686	0.674
13	Bireuen	0.661	0.623	0.634	0.688	0.644
14	Gayo Lues	0.188	0.267	0.269	0.233	0.274
15	City of Banda Aceh	0.797	0.714	0.719	0.762	0.732
16	City of Langsa	0.108	0.126	0.148	0.141	0.152
17	City of Lhokseumawe	0.646	0.598	0.619	0.679	0.621
18	City of Sabang	0.800	0.638	0.653	0.651	0.807
19	City of Subulussalam	0.385	0.471	0.474	0.474	0.495
20	Nagan Raya	0.698	0.640	0.650	0.715	0.664
21	Pidie	0.711	0.701	0.694	0.747	0.721
22	Pidie Jaya	0.652	0.612	0.636	0.665	0.644
23	Simeulue	0.617	0.787	0.785	0.718	0.806
Average		0.591	0.589	0.598	0.621	0.612
Regional Disparity		0.297	0.265	0.256	0.270	0.255

Source: Authors' calculation

ing that these districts/municipalities are less developed. The average difference between the IDI scores of both categories is 0.692.

Thus, it can be concluded that infrastructure development remains concentrated in some regions such as in the central of the province and other big cities in Aceh. On the one hand, it is common that the cities undergo major development since it sustains all vital economic activities, all of which are mostly carried out intensively in the province capital. On the other hand, when the process of development and the demand for investment lead to an increase in the concentration of the capital, it will lead to the concentration of wealth. As the result, it will increase the division between the poor or middle-classes and the wealthy-investor class (Kaldor 1957; Zali et al. 2013).

In detail, the highest values of IDI range from 0.745 to 0.807 while the lowest only vary between 0.108 and 0.376. The mean index score of IDI for all the regions is 0.597 and the standard deviation is 0.1620. Meanwhile, the coefficient of variations

decreases until the last year period, meaning that regional disparity experiences small decreases in the 5 years of the study. To be specific, it varies between 0.297 and slowly decreases to 0.255 in 2019.

Table 5 shows the GDP/capita for each district and municipality in Aceh Province which also shows some variations across regions. Based on the amount of GDP/capita, the districts/municipalities can be divided into two groups: the average GDP/capita below the average and above the average.

In detail, Banda Aceh and Nagan Raya have the highest amount of GDP/capita while Aceh Singkil and Aceh Tenggara produce the lowest GDP/capita among other districts/municipalities. Interestingly, it appears that the infrastructure that forms the composite index may correlate with GDP/capita. More specifically, some regions with a high value of IDI also generate a high amount of GDP/capita, such as Banda Aceh, Lhokseumawe, and Nagan Raya. On the other hand, the districts/municipalities

Table 5. GDP/capita by Districts/Municipalities in Aceh Province

No	Districts/Municipalities	GDP/capita (in million IDR)				
		2015	2016	2017	2018	2019
1	Aceh Barat	26.627	26.832	29.796	31.977	33,212
2	Aceh Barat Daya	17.836	18.308	18.808	19.372	19,968
3	Aceh Besar	21.685	22.086	22.508	22.962	23,527
4	Aceh Jaya	19.800	20.295	20.691	21.108	21,468
5	Aceh Selatan	15.894	16.362	16.763	17.306	17,799
6	Aceh Singkil	12.916	13.200	13.406	13.681	13,977
7	Aceh Tamiang	18.448	18.647	19.118	19.677	20,286
8	Aceh Tengah	25.356	25.946	26.494	27.023	27,380
9	Aceh Tenggara	14.605	14.926	15.345	15.519	15,901
10	Aceh Timur	18.016	17.472	17.831	18.280	18,706
11	Aceh Utara	26.006	25.601	25.896	26.751	27,321
12	Bener Meriah	22.442	22.929	23.418	23.964	24,479
13	Bireuen	19.485	19.899	20.275	20.753	21,364
14	Gayo Lues	19.541	19.959	20.611	20.857	20,536
15	City of Banda Aceh	50.838	53.076	53.635	54.930	56,122
16	City of Langsa	19.559	20.089	20.649	21.235	21,862
17	City of Lhokseumawe	34.221	33.099	33.136	33.634	34,344
18	City of Sabang	27.487	28.472	29.885	31.093	32,615
19	City of Subulussalam	15.087	15.461	15.920	16.302	16,688
20	Nagan Raya	34.965	35.657	36.371	37.207	38,774
21	Pidie	15.742	16.085	16.535	16.987	17,498
22	Pidie Jaya	14.653	14.919	15.445	15.830	16,156
23	Simeulue	15.089	15.570	16.057	16.600	17,212
Average		22,013	22.387	22.982	23.611	24.226

Source: *Aceh dalam Angka* (BPS Aceh Province Office)

with a low value of IDI also generate a low amount of GDP/capita, such as Gayo Lues, Langsa, and Aceh Barat Daya. These lead to the discussion on the impact of IDI on economic performance in the next section.

4.2. The Impact of IDI on the Economy of Aceh Province

Table 6 shows the results of path analysis (path coefficients and R^2 values). Poverty rate is directly affected by per capita village electrified, per capita consumption of electricity, length of road, number of hotels, villages connected by roads, number of banks, base transceiver station, number of markets, and unemployment. The R^2 value from model 1 is 0.227, meaning that the independent variables simultaneously explain 61.7% of the variance of poverty rate. Meanwhile, unemployment rate and regional GDP per capita are both directly affected by per capita village electrified, per capita consumption of electricity, length of road, number of hotels, villages connected by roads, number of banks, base

transceiver station, number of markets, and poverty. However, the R^2 value from model 2 is 0.227 while the R^2 value from model 3 is 0.611. That is, the independent variables simultaneously explained 22.7% of the variance of poverty rate and 61.1% of the variance of regional GDP per capita.

Per capita village electrified has a significant and positive impact on regional GDP/capita although its impacts on poverty rate and unemployment are not statistically significant. Furthermore, per capita consumption of electricity significantly correlates with lower poverty rate, albeit no significant correlation with regional GDP/capita and unemployment rate. As Maqin (2011) reported, electricity is a crucial factor to enable other productive economic activities which in turn spur the economic growth of districts/municipalities. However, our result suggests that the provincial economic growth caused by village electrification does not necessarily transform into poverty reduction and employment creation. The poorest and the least-skilled group in the society may not directly or immediately utilize the electricity provision to create productive economic

Table 6. Path Coefficients and R² Values

Variables	Poverty Rate (1)	Unemployment Rate (2)	Regional GDP Per Capita (3)
Per capita village electrified (pve)	16.783	2.678	23.574***
Per capita consumption of electricity (pcon)	-1.143**	0.005	-0.031
The length of road (rlt)	-0.150***	-0.015**	0.014
The number of hotels (htl)	-0.074**	-0.011	0.076***
Villages connected by road (vcrl)	1.886	0.536	-0.184
The number of banks (banpl)	0.099	0.100***	0.796***
Base transceiver station (mobl)	0.281***	0.012	-0.036
The number of markets (psar)	0.878***	-0.004	-0.138*
Unemployment (unemp)	0.72		
Poverty (pov)		0.02	-0.025
_cons	99.637**	1.866	-2.455
N	115	115	115
R-sq	0.617	0.227	0.611
adj. R-sq	0.584	0.161	0.578

Source: Authors' calculation

Note: (*), (**) and (***) represent $p < 0.10$, $p < 0.05$ and $p < 0.01$, respectively

activities (Dong & Hao 2018; Bridge, Adhikari & Fontela 2016; Niu et al. 2013). As Maqin (2011) noted, electrification will lead to poverty alleviation and job creation only if it is accompanied by the quality improvement of labor force and government spending.

The length of road significantly correlates with poverty rate and unemployment rate in negative direction. In other words, road development has positive impact on poverty reduction and employment opportunities creation, despite no significant impact on regional GDP growth. Moreover, the percentage of villages connected by roads also has no significant effect to poverty rate, unemployment rate, and regional GDP growth. Iqbal (2017) reports that road network is positively associated with regional equality. Roads are a highly important aspect to increase people and goods' access and mobility, especially in areas that are far from the center of economic activities. However, the insignificant estimated coefficient of the percentage of villages connected by roads may indicate that in the rural areas in Aceh Province, the economic growth is still concentrated in the center of sub-districts and has not spread to villages.

The number of hotels significantly correlates with increasing regional GDP/capita and lower poverty rate, despite no significant relation with unemployment rate. The development of accommodations

usually marks the growing tourism and other services sectors, hence positively correlates with a region's economic performance (Setiawan et al. 2019; Widiastuti 2013).

The number of banks has a positive and significant impact on regional GDP/capita. However, the number of banks significantly correlates with increasing unemployment rate and also correlates with rising poverty rate, despite not significant statistically. The presence of banks can improve the transaction efficiency and mediate the member of the society with extra fund with those needing the fund through its savings and loans facilities hence enhance economic growth in general (Devi 2016; Abdurrohman 2003; Agung & Ford 1998). However, the result also shows that the provision of credit and other financial access will not by itself creating employment, without strengthening the financial literacy of the society (Arias 2015; Mugo & Kilonzo 2017; Erlando, Riyanto & Masakazu 2020). Firstly, the financial sectors may have limitations in expanding its financial program outreach to people in remote rural areas. Evidence suggests that the main reasons people in rural areas do not start saving at and borrowing from the bank are due to higher transaction costs, higher risks, and more unfavourable contracting environment that makes it more difficult for financial institutions to achieve and maintain sustainability in rural compared to urban areas (Lopez & Winkler

2018; Dupas et al. 2012). Second, some people in the community may have low financial literacy (Kesa 2019). Low financial literacy may hamper the welfare improvement effect of bank loans, especially because the poor loans management by households may lead to the debts burden (Gathergood 2012).

The presence of base transceiver station (BTS) significantly correlates with higher poverty rate. It also correlates with lower regional GDP/capita and higher unemployment rate, albeit with no statistical significance. The result shows that the BTS running as facilities to provide wireless communication and internet access in an area will not by itself improve economic performance of a region, reduce the poverty, and create jobs. One of the necessary conditions to transform the telecommunication access into household productive activities is the level of education (Chevalier et al. 2004) and internet literacy (Boothby, Dufour & Tang 2010). Otherwise, the improving communication access will increase communication activity, hereby household spending on communication, without necessarily transform into additional income (Nasution 2016).

Finally, the number of traditional markets surprisingly has significant and negative correlation with regional GDP/capita. It surprisingly also has significant correlation with higher poverty rate of Aceh Province. A market is supposed to be a medium where most economic transactions occur. However, the market often cannot be accessed by some members of societies because of the long distance of the villages to the market which are mostly located in the center of sub-districts. In addition, traditional markets have gradually lost its traditional function due to the internet penetration in the rural areas, growing online media and markets, and increasing number of consumers who prefer online shopping (Do, Nguyen & Nguyen 2019). Furthermore, the internet access allows people to arrange a meeting in a closer location to perform business transaction without having to visit the market (Frick & Matthies 2020). Hence, the traditional market currently may not serve as the

best indicator of economic performance of an area.

5. Conclusion

In conclusion, infrastructure development is an important aspect of economic growth. Infrastructure development will ensure economic efficiency, accelerate the movement of goods and services, increase the added value of the economy, as well as become a driving factor for regional productivity. However, the result shows that there is regional disparity in both infrastructure development and economic performance among the districts/municipalities in Aceh Province. However, the disparity is significantly small and the level slightly decreases in the five-year period measured (2015–2019).

Based on the IDI, Aceh Besar, Simeulue, and Banda Aceh are three districts/municipalities with the highest development index, which implies that they have utilized various infrastructural facilities properly. The value of IDI also defines Langsa, Gayo Lues, and Aceh Barat Daya as the less developed regions. Therefore, it is better to prioritize the districts/municipalities of a low level of IDI such as Langsa, Gayo Lues, and Aceh Barat Daya. On this regard, this is related to the development of infrastructure to sustain the economic growth in each district and reduce the gap among the districts/municipalities around Aceh Province.

The value of the IDI determines the position of each district/municipality. Specifically, electricity, the number of hotels, and the length of road are highly potential to influence the growth of regional domestic product per capita, reduce the unemployment or reduce poverty rate in the province. Therefore, to raise regional domestic product per capita and reduce the level of poverty, the government should take necessary actions to create better infrastructural facilities in order to improve the economic growth and standard of living for people.

Referring to the result obtained, it is also recommended for the government to prioritize the develop-

ment of infrastructure or facilities with high level of significance whether to the reduction of poverty and unemployment rate or the improvement of regional GDP/capita. Specifically, prioritizing the investment in roads, hotels or accommodations, as well as the electricity, may have high potential for improving economic growth and lowering the unemployment and poverty rate.

However, the results of this study also imply that physical infrastructure alone may not be sufficient to drive economic performance. The presence of banks (financial access) and the provision of internet access do not necessarily lead to higher economic growth, lower unemployment rate and lower poverty rate without improvement in society's financial and technology literacy. Therefore, further studies are needed to investigate how other types of infrastructure such as educational, health, as well as social infrastructure, may improve economic growth and eventually reduce the inequality.

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