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THE IMPACT OF REAL GOVERNMENT SPENDING IN PHYSICAL AND SOCIAL INFRASTRUCTURES ON ECONOMIC GROWTH

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ABSTRACT
Most countries in the world undertake some approaches to achieve high and sustainable economic growth which represents the economic welfare of countries. This study aims to analyze the effect of real government spending in the physical and social infrastructures on economic growth in Indonesia using panel data from 33 provinces in the period of 2005 to 2018. The economic growth model is affected by capital with flow characteristic, which in this study are divided into physical and social infrastructures. Therefore, Dynamic Panel ARDL model is employed to investigate functional relationship between the economic growth and the public capital stocks in the short-term and long-term. The results show that all variables except the Road and Bridge (RB) which has a significant positive effect, have a negative effect on economic growth in the short-term. In the long-term, Roads and Bridges (RB) and Irrigation Channels (IC) have a positive and significant effect on economic growth, while the others do not. These results are also supported by the Pedroni and KAO Cointegration Tests. These underline that public infrastructure as capital stocks of each region with the appropriate infrastructure development plays an important role in sustaining the economic growth in Indonesia.

Keywords: Dynamic ARDL Model, Economic Growth, Physical and Social Infrastructures, Real Public Expenditure

JEL classification:
C33, H54, O40

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INTRODUCTION

Many economists highlight that a high economic growth is the primary goal of every nation since the higher economic growth depicts higher societal welfare standards (Bhalla & Meher, 2019; Kumari & Sharma, 2017; Ndedi et al., 2017; Neneh & Vanzyl, 2014; Rathnayaka et al., 2018; Yangka et al., 2018). The growth also indicates a benchmark for development and one of the Sustainable Development Goals (SDGs) (UNDP, 2019). To obtain the expected economic growth, the government provides public goods (Hyman, 2011) which could boost higher economic growth (Flavin, 2019). However, the fact shows that higher economic growth is mostly not accompanied by the equal income distribution (Canh et al., 2020). Therefore, the inclusive economic growth concept is required which can be an attractive alternative (Tang, 2008).

Inclusive economic growth is not only increasing national income or output but also including equal employment opportunities and non-discriminatory participation (Corrado & Corrado, 2017; Klasen, 2010; Anand et al., 2013). The government with good governance becomes a robust foundation for the success of inclusive economic growth implementation (Oyinlola et al., 2020). Infrastructure could support inclusive economic growth in the future by locking the direction of development, as illustrated by the transportation network for the underdeveloped areas (Välilä, 2020). Moreover, it also becomes priorities for public goods provision in Indonesia (BAPPENAS, 2015).

APPLICATIONS FOR PRACTICE

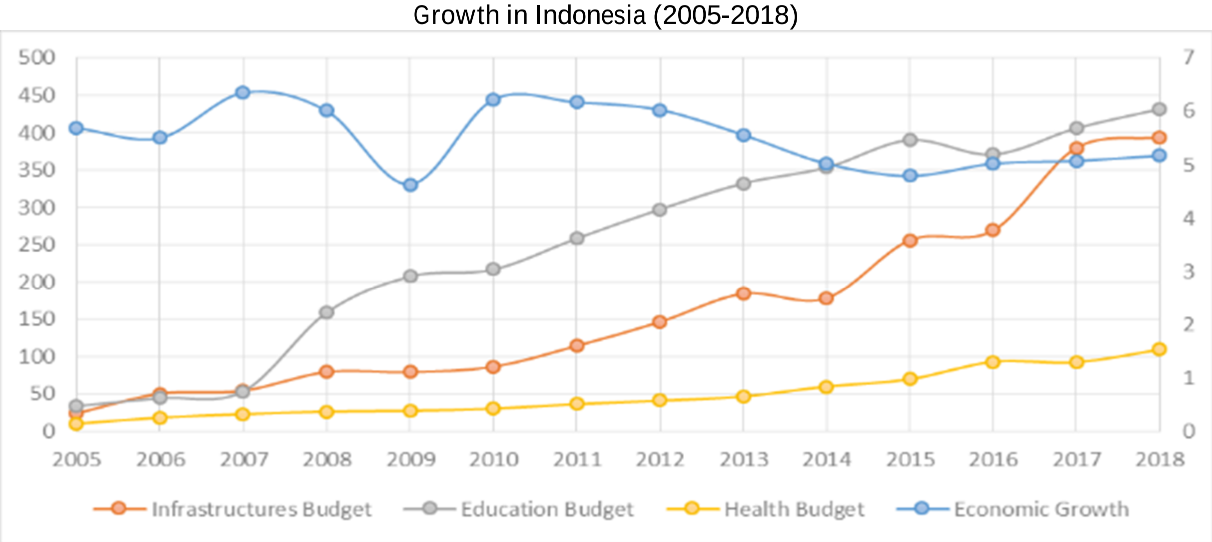
1. This study examines the substantial impact of infrastructures on economic growth
2. The effect of physical infrastructure is significant and larger than the effect of social infrastructure on economic growth
3. The government should conduct more in-depth studies to determine the type of infrastructure that is most suitable for each province so it can play an optimal role in boosting its surrounding economic growth.

According to BAPPENAS (2015), in providing the infrastructures, the government refers to the Medium-term Development Plan (2015-2019), which includes the national government strategy, policy, and economic framework. This plan is implemented in the government work plan that is carried out annually through the state budget. The state budget contains all government expenditures, including infrastructures.

In 2005, infrastructure investment reached 23.7 trillion Rupiah or about 5 percent of the total expenditure. In the following year, it doubled to 50 trillion Rupiah. This phenomenon continued until reaching 184 trillion Rupiah in 2013. In recent years, infrastructure provision has increased significantly.

The increase in government spending was not correlating with economic growth as expected. This can be reflected in the period between 2008 and 2009 where the education budget increased significantly while the budget for health and infrastructure remained relatively constant; and

Chart 1. The Comparison of Infrastructure Budget, Education Budget, Health Budget, and Economic Growth in Indonesia (2005-2018)



Source: Data Preprocessing

then, the economic growth declined from the previous 6.01 percent in 2008 down to 4.63 percent in 2009. A similar event reoccurred in the period of 2014 and 2015, when the government infrastructure budget increased significantly, and the education budget was in a moderately increasing condition. However, the economic growth decreased by 5.02 percent in 2014 and 4.79 percent in the following year. Overall, the infrastructure budget increased by more than 20 percent annually, but it was not followed by significant growth in the economy.

Based on these conditions, examining the impact of physical infrastructures (road and bridge, irrigation channel, airport, and port) and social infrastructures (health and education) on economic growth is an intriguing topic to discuss. In Indonesia, several previous studies on relevant issues have been conducted using a combination of both physical and social infrastructure factors. However, they do not use infrastructure budget realization as the main variable. Thus, this study considers budget realization as the main variable in analyzing the economic growth which seems allegedly the novelty of this research. Therefore, the authors are interested to conduct this research in a full inquiry. In addition, this study uses secondary data which includes 33 provinces in Indonesia from 2005 to 2018.

The research questions for this study include: (1) how is the distribution of infrastructure conditions throughout provinces in Indonesia? (2) How much the impact of the government's spending for physical and social infrastructures on the economic growth in Indonesia? and (3) Does equilibrium condition occur to physical and social infrastructures on economic growth in the short and long-term?

This study intends to provide a comprehensive view of infrastructure conditions in each province in Indonesia. Here, it analyzes an infrastructure comparison among Indonesian provinces. Furthermore, this study also aims to examine the effect of physical and social infrastructures on economic growth in Indonesia. The further inquiry of this study is to prove whether stable condition exists for all variables in the short and long-term.

There are two main contributions of this research. First, we analyze the impact of the physical and social infrastructures on Indonesia's economic growth. This analysis is needed to explain the relationship between physical and social infrastructures as well as economic growth in the short and long-term, including their balance relationship. Second, we perform a specific ratio between total government expenditure (in billion Rupiah) for each variable and the total output produced. The ratio comparison enables us to explain the inequality of infrastructure developed in Indonesia. The comparison provides a more in-depth view of the condition of infrastructures among provinces in Indonesia and directly supports the first stated analysis (Hoyos & Olariaga, 2020).

In addition, three main points distinguish this study from previous studies. First, this study analyzes both physical and social infrastructures simultaneously to determine their effects on economic growth in Indonesia. Referring to the previous researcher, Kumari & Sharma (2017) showed that both infrastructures have a positive and significant impact on economic growth in India. Second, the previous studies do not consider the government expenditure or budget realization as the main variable related to this issue. The state budget reflects all government investments. Thus, the usage of this variable in the growth model is appropriate. In addition, the total investment also represents the quality of the infrastructure (Coelho & Vilares, 2010; Khan et al., 2018). Third, the comparison analysis between total investments and the total output which gives an infrastructure ratio would be a novelty in this study. This calculation is needed to find out whether infrastructure inequality exists in Indonesia so that a deep understanding of the actual situation of the regions can be presented.

LITERATURE REVIEW

Economic growth

Economic growth describes the economic condition of a country related to economic welfare. It is usually characterized by growth in production, consumption, poverty reduction, or health and education improvement. To measure economic growth, Gross Domestic Product (GDP) data is used. Inclusive economic growth should be pro-poor, in which the poor people receive higher growth than others (Tang, 2008; White & Anderson, 2000). Inclusive economic growth is also defined as economic development that prioritizes infrastructures.

Government spending, government expenditure, and government investment

In a macroeconomic view, government expenditure or government spending is the same term used in calculating the GDP variable (Azwar, 2016). In addition, government spending is the main pillar of fiscal policy to amend income distribution (Nguyen & Su, 2022). Another definition refers to the state budget law 2022 stressed that government expenditure is an obligation recognized as a net worth reduction. Government investment is an allocation of a fund or financial assets in long-term to obtain an economic or social benefit for the people's prosperity. In practice, public goods and services procurement reflects government spending, government expenditure, and government investment. Based on these definitions, in this study, government spending, government expenditure, and government investment basically have a similar meaning. Thus, the term budget realization is employed to represent physical infrastructure and social infrastructure.

Infrastructures

The term Infrastructure can be derived from French, which contains two words, "infra," which means "under" and "structure," which means "form" (Kumari & Sharma, 2017). Based on Macmillan Dictionary of Modern Economics as quoted by Pamungkas, infrastructure is a structural element of the economy that connects buyers and sellers. While according to Rutherford (2012), infrastructure is the main service of a country that allows economic and social activities to occur by providing transportation, public health services, educational services and buildings for community purposes. Other scholars define infrastructure as a physical system which produces transportation, irrigation, drainage, buildings and other public facilities to meet human basic needs in the social and economic sphere (Kodoatie, 2005; Syadullah & Setyawan, 2021).

Furthermore, Pranessy et al. (2012) explained that infrastructure is an important input for production activities and it can affect the economy in various ways, either directly or indirectly. It can be interpreted as a set of interrelated structural elements which support the overall development structure framework including this as well as the physical component of the interrelated system. It also provides access to both commodities and services that enable to maintain or reach people's living conditions (Kumari & Sharma, 2017). It means that it is not only a production activity that will create output and employment opportunities, but the existence of infrastructure also affects the efficiency and smoothness of economic activities in other sectors.

Infrastructure is classified into two categories: physical and social infrastructures. Physical infrastructure is needed to directly support economic activities, such as roads, ports, and airports, while social infrastructure increases the efficiency and the ability of the workforce, such as education and health (Dash & Sahoo, 2010; Kumari & Sharma, 2016).

Previous studies

Although many studies have been carried out previously on this issue, they only focused on certain types of infrastructure, such as physical infrastructure. Those include studies conducted by Maparu & Mazumder, (2017) and Saidi et al., (2018) which detect a positive relationship between infrastructure and economic growth. Physical infrastructure is represented by roads and other transportation (Chakrabarti, 2018; Tong & Yu, 2018). Other researchers examined the relationship between economic growth and water consumption for agriculture (Doungmanee, 2016), airports (Hakim & Merkert, 2016; Marazzo et al., 2010; Khan et al., 2018), and the ports that continue to adapt and contribute to its surrounding economic activities (Miller, 2017). Further, findings indicate a causal relationship between infrastructure and economic growth (Maparu & Mazumder, 2017). Investment in infrastructure does not have an immediate impact and tends to be long-term (Pradhan, 2019). However, the opposite opinion was expressed by Shi et al., (2017), which stated that infrastructure investment has various effects on economic growth. In addition, this study also found that continuous road construction will generate a negative impact on economic development in some regions because of the crowding-out effect, which is in line with the "law of diminishing return" theory.

A similar condition also occurs for social infrastructure. Thompson (2018) highlighted that social capital could stimulate innovation, which drives economic growth. These can be obtained by investing more in public goods, which increases people's happiness and quality of life (Flavin, 2019). The health impact is proven (Gallardo-Albarrán, 2018) and considered more influential than education (Ogundari & Awokuse, 2018). It means that good health will produce high productivity although high economic growth could spur pollution and high-stress level (Wang & Granados, 2019). However, other research also shows that access to education has a positive and significant impact on economic growth (Donou-Adonsou, 2019). It means that both factors are essential in increasing economic activity.

In general, most of the previous studies only analyzed one type of infrastructure and only a few that examined the effect of both infrastructures (physical and social) on economic growth. Kumari & Sharma (2017) is one of the researchers who discussed the effect of the two infrastructures on economic growth. They explained that there is a positive and significant contribution of physical and social infrastructures to economic growth in India. Physical infrastructures are represented as basic needs such as roads, electricity, and water. Social infrastructures are related to the improvement of the life quality of society. Furthermore, they emphasized that both infrastructures have a positive and significant effect on economic growth. This research used annual time series data from 1995 to 2001. The augmented Dickey-Fuller test and Phillips Peron unit root test were employed to observe the stationary nature of the data series. Unrestricted VAR and Granger causality tests were conducted to assess the underlying causal link between economic growth, physical and social infrastructures. Their result showed that physical or economic infrastructure and social infrastructure have a positive relationship with economic growth in India.

Based on the previous studies, the hypotheses of this study are (1) physical infrastructure and social infrastructure have a positive and significant effect on economic growth in Indonesia (H1), and (2) Equilibrium condition occurs for all variables observed in the short-term and long-term (H1). In addition, the analysis of the physical infrastructure and social infrastructures condition throughout provinces in Indonesia does not have a hypothesis due to the descriptive analysis employed (Gonzalez et al., 2022).

RESEARCH METHODOLOGY

In this study, the quantitative method was used and supported by descriptive analysis. First, descriptive statistics was conducted by comparing the total government expenditure that had been invested in each infrastructure with its total output. This analysis aims to provide a comprehensive analysis of the actual condition regarding the genuine distribution of each variable among the provinces in Indonesia. Second, inferential statistics was employed as an appropriate model to find the effect of independent variables (physical and social infrastructure expenditures) on the dependent variables (economic growth), including their balance relationship.

Data used in this study was secondary annual data. The data category was presented in panel data, which is a combination of cross-section data and time-series data from 33 provinces in Indonesia from 2005 to 2018. This panel data is highly dependent on the availability of the government's annual financial realization reports of each province. This provides an opportunity for further research by using longer panel data in line with this issue. The dependent variable is economic growth (EG) and the independent variables are classified into the budget realization of road and bridge (RB), irrigation channel (IC), Airport (AI), Port (PO), Education (ED), and Health (HE) budget realization.

A descriptive approach was employed to obtain a profound understanding the relationship of the variables by comparing total infrastructure investment to the total output that has been produced. Total infrastructure investment is represented by total central government expenditure in the state budget. Total government expenditure is stated in billions of Rupiah. Output for physical infrastructure is represented in the form of the amount, size and volume of physical infrastructure as stated in the State Property Report, which is published annually. In addition, education and health infrastructures stand for social infrastructures which are measured by the average length of schooling and the average life expectancy, respectively.

This comparison allows us to obtain the ratio of each variable of each province in Indonesia. The smaller infrastructure ratio means the investment needed to reach one unit of output is also smaller, and vice versa. Furthermore, the ratio is juxtaposed to obtain which areas have the most significant and smallest ratios. The difference between the smallest ratio and the most significant ratio shows the real inequality that occurs in the provinces in Indonesia.

Moreover, in determining the appropriate model for the inferential approach, unit root tests are mandatory (Im et al., 2003; Lee & Strazicich, 2013; Pesaran, 2014). Two types of unit root tests used are (1) ADF (Augmented Dickey-Fuller) Fisher Chi-Square (ADF Fisher) with Schwarz Info Criterion, and (2) PP-Fisher (Phillips and Perron) using Newey-West Bandwidth. If the result of unit root tests indicates that the variables are stationary in different orders (I(0) or I(1)), then the panel Autoregressive Distributed Lag (ARDL) model will be appropriate to use in this study (Doğan et al., 2014).

The co-integration test will be implemented to find out whether there is a long-term balance relationship between the variables and also to explain whether there are similarities in the movement and stability of the relationship among the variables in this study (Badalyan et al., 2014). Co-integration test employed is panel co-integration with Pedroni and KAO' criteria (Pedroni, 1999, 2001; Westerlund, 2006). The panel ARDL model is used to examine the role of time, theory justification, and the relationship between variables (Gujarati, 2004; Salisu & Isah, 2017). The basic equation for the ARDL model (Doğan et al., 2014) is presented as follows:

$$Y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \theta_i \gamma_{t-1} + \beta' X_t + \sum_{i=0}^{q-1} \beta^{*\prime} \Delta X_{t-i} + u_t \quad (1)$$

$$\Delta X_t = P_1 \Delta X_{t-1} + P_2 \Delta X_{t-2} + \dots + P_i \Delta X_{t-i} + \varepsilon_{t}.. \quad (2)$$

where X_t refer to a -k (I(1)) dimension which is not co-integrated by itself, u_t and ε_t are assumed to have no serial relationship between errors with zero mean and constant variance-covariance, respectively. P_i stands for the matrix coefficient which is an autoregressive vector process in ΔX_1. The dynamic ARDL model equation using panel data is shown as follows:

$$Y_{j,t} = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \theta_i Y_{j,t-i} + \beta' X_{i,t} + \sum_{i=0}^{q-1} \beta^{*\prime} \Delta X_{j,t-1} + u_{j,t} \quad (3)$$

Furthermore, we substitute equation (3) into the research variable so that the equation yields:

$$EG_{j,t} = \alpha_{0i} + \sum_{i=1}^{n} \alpha_{1i} RB_{i,t-1} + \sum_{i=1}^{n} \alpha_{2i} IC_{i,t-1} + \sum_{i=1}^{n} \alpha_{3i} AI_{i,t-1} + \sum_{i=1}^{n} \alpha_{4i} PO_{i,t-1} + \sum_{i=1}^{n} \alpha_{5i} ED_{i,t-1} + \sum_{i=1}^{n} \alpha_{6i} HE_{i,t-1} + \beta_{11} RB_{j,t-1} + \beta_{21} IC_{j,t-1} + \beta_{31} AI_{j,t-1} + \beta_{41} PO_{j,t-1} + \beta_{51} ED_{j,t-1} u_{j,t} + \beta_{61} HE_{j,t-1} + u_{j,t} \quad (4)$$

Where α_1 to α_6 are the short-term coefficients, β_1 to β_6 are the long-term coefficients, t is the year from 2005 to 2018, j is the 33 provinces in Indonesia and the length of the lag sequence, and u is the error term. The short-term estimation refers to research conducted by Bildirici & Kayikci (2013) using the following equation:

$$EG_{j,t} = \alpha_{0i} + \sum_{i=1}^{n} \alpha_{1i} RB_{j,t-i} + \sum_{i=1}^{n} \alpha_{2i} IC_{j,y-i} + \sum_{i=1}^{n} \alpha_{3i} AI_{j,t-i} + \sum_{i=1}^{n} \alpha_{4i} PO_{j,t-i} + \sum_{i=1}^{n} \alpha_{5i} ED_{i,t-1} + \sum_{i=1}^{n} \alpha_{6i} HE_{i,t-1} + \theta_1 ECT_{t-1} + u_{4it} \dots\dots \quad (5)$$

Where, H_a: $\alpha_{1i} \neq \alpha_{2i} \neq \alpha_{3i} \neq \alpha_{4i} \neq \alpha_{5i} \neq \alpha_{6i} \neq 0$; so, there is a short-term effect.
Meanwhile, long-term relationship is based on Pesaran & Smith (1995) with an equation:

$$EG_{j,t} = \beta_{01} + \beta_{11} RB_{j,t-1} + \beta_{21} IC_{j,t-1} + \beta_{31} AI_{j,t,1} + \beta_{41} PO_{j,t,1} + \beta_{51} ED_{j,t,1} + \beta_{61} ED_{j,t,1} + \varepsilon_t \quad (6)$$

Where, H_a: $\beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq \beta_{4i} \neq \beta \neq \alpha_{6i} \neq 0$; as such, there is a long-term effect.

Table 1. Descriptive Statistics

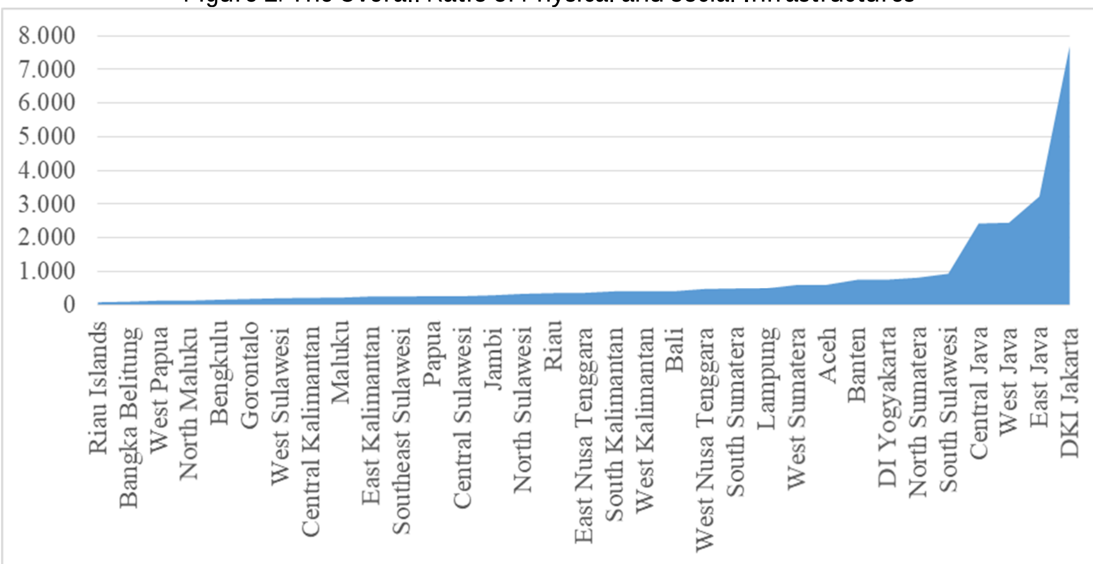
Variables	Min	Max	Mean	Std.Dev
Economic growth (EG)	-17.14 (-17.00)	36.40 (36.30)	5.70 (5.73)	3.34 (3.36)
Road and Bridge (RB)	0.00 (0.00)	127063.4 (1788.49)	819.76 (4.70)	6007.68 (84.74)
Irrigation Channel (IC)	0.00 (0.00)	6211.59 (12.05)	290.53 (0.43)	494.52 (1.05)
Airport (AI)	0.00 (0.00)	877.12 (1.69)	57.25 (0.09)	128.39 (0.25)
Port (PO)	0.00 (0.00)	2870.88 (22.45)	82.91 (0.73)	227.99 (2.08)
Education (ED)	0.00 (0.00)	62.26 (191337.8)	2.82 (4390.49)	6.77 (20664.72)
Health (HE)	0.00 (0.00)	44.39 (10041.12)	0.74 (118.60)	3.73 (860.51)

Source: Data processing

Note:

1. *Budget realization from http://www.data-apbn.kemenkeu.go.id/Dataset*
2. *Economic growth from Statistics Indonesia*
3. *() the number in brackets refers to the weighted average*

Figure 1. The Overall Ratio of Physical and Social Infrastructures



Source: Data processing

To obtain a comprehensive analysis, this study constructs a weighted model by multiplying each dependent variable with the ratio obtained from descriptive approach. This new model will help us broaden our understanding regarding infrastructure effect on economic growth. The equation for this model is given as follows:

$$EG_{j,t} = \alpha_{0i} + \sum_{i=1}^{n}\alpha_{1i}WRB_{i,t-1} + \sum_{i=1}^{n}\alpha_{2i}WIC_{i,t-1} + \sum_{i=1}^{n}\alpha_{3i}WAI_{i,t-1} + \sum_{i=1}^{n}\alpha_{4i}WPO_{i,t-1} + \sum_{i=1}^{n}\alpha_{5i}WED_{i,t-1} + \sum_{i=1}^{n}\alpha_{6i}WHE_{i,t-1} + \beta_{11}WRB_{j,t-1} + \beta_{21}WIC_{j,t-1} + \beta_{31}WAI_{j,t-1} + \beta_{41}WPO_{j,t-1} + \beta_{51}WED_{j,t-1}u_{j,t} + \beta_{61}WHE_{j,t-1} + u_{j,t} \quad (7)$$

RESULT AND DISCUSSION

First, to generate a comprehensive analysis, this study starts with a descriptive analysis to obtain a complete understanding of physical and social infrastructures in 33 provinces in Indonesia.

Descriptive statistics (Table 1) helps us understand the conditions of distribution of physical and social infrastructures among Indonesia's provinces. The most notable one is the negative value in the economic growth because a particular province (Aceh) was destroyed by a natural disaster (tsunami) at the end of 2004. All variables show a large gap between minimum and maximum values, which indicates tremendous inequality between infrastructure investments among 33 provinces in Indonesia.

The infrastructure inequality ratio is calculated by comparing the total expenditure and output of each variable in each province. Even though many factors can affect the total output, such as the difference in labor cost or material cost, at least, this ratio can illustrate the existed gap. A higher ratio means that the required expenditure is more substantial to increase one unit of output, and vice versa.

Based on Figure 1, Riau Island has the lowest average of overall infrastructure ratio. It indicates that this province has the smallest investment needed to obtain one unit of output in both infrastructures. Other provinces, such as Bangka Belitung, West Papua, North Maluku, and Bengkulu, also have a relatively small ratio. On the other hand, several provinces, such as DKI Jakarta, East Java, West Java, Central Java, and South Sulawesi, have a relatively high ratio. This means that these provinces have higher investment to easily generate each unit of output.

Table 2. The unit root test result (Individual Intercept and Trend)

Variable	ADF-Fisher		PP-Fisher	
	I(0)	I(1)	I(0)	I(1)
EG	79.4426 (0.1238)	119.885 (0.0001)	166.918 (0.0000)	-
RB	84.1040 (0.0658)	152.155 (0.0000)	228.715 (0.0000)	-
IC	101.844 (0.0031)	-	150.614 (0.0000)	-
AI	102.208 (0.0017)	-	273.179 (0.0000)	-
PO	96.5187 (0.0085)	-	171.048 (0.0000)	-
ED	117.280 (0.0001)	-	207.738 (0.0000)	-
HE	67.2214 (0.435)	158.703 (0.000)	38.9530 (0.9968)	331.898 (0.000)

Source: Data processing

Table 3. The Unit Root Test Result Based on Weighted Average Data (Individual Intercept and Trend)

Variable	**ADF-Fisher**		**PP-Fisher**	
	I(0)	**I(1)**	**I(0)**	**I(1)**
EG	79.557 (0.1220)	120.014 (0.0001)	169.025 (0.0000)	-
WRB	87.442 (0.0399)	-	227.983 (0.0000)	-
WIC	101.844 (0.0031)	-	150.614 (0.0000)	-
WAI	102.208 (0.0017)	-	273.179 (0.0000)	-
WPO	96.519 (0.0085)	-	171.048 (0.0000)	-
WED	117.280 (0.0001)	-	207.738 (0.0000)	-
WHE	67.221 (0.4350)	158.703 (0.000)	38.953 (0.9968)	337.898 (0.0000)

Source: Data processing

Note: All variables observed in Table 3 are the weighted values

From this figure, it is clear that there is a significant gap among provinces in Indonesia. These findings once again highlight that infrastructure inequality exist among Indonesia's provinces and still considered high. This condition is strengthened by the highly differences in descriptive statistics (Table 1) and physical and social capital ratio (Figure 1).

Second, to specify the relationship between the two types of infrastructures and economic growth, this study has to determine the appropriate regression model. The results of the unit root test (Table 2) reveal that some variables such as IC, AI, PO, and ED are stationary at the level. Other variables such as EG, RB, and HE are stationary at first difference. These results strengthen the selection of the dynamic panel ARDL model as an appropriate model for this study.

Table 4. Panel Co-integration Test Result (Individual Intercept and Trend)

Pedroni Co-integration Test	***Statistic***	***Weighted statistic***
Panel v-Statistic	-2.197496 (0.9860)	-5.517637 (1.0000)
Panel rho-Statistic	6.464261 (1.0000)	7.078311 (1.0000)
Panel PP-Statistic	-7.703716 (0.0000)*	-4.561542 (0.0000)*
Panel ADF-Statistic	-6.654728 (0.0000)*	-3.057071 (0.0011)*
Group rho-Statistic	9.239885 (1.0000)	
Group PP- Statistic	-5.739735 (0.0000)*	
Group ADF-Statistic	-2.532973 (0.0057)*	
KAO Co-integration Test	t-statistic	
ADF	-4.666466 (0.0000)*	

Source: Data processing

*Note: * significant at 1 and 5 percent*

Table 5. Panel Co-integration Test Result for Weighted Average (Individual Intercept and Trend)

Pedroni Cointegration Test	***Statistic***	***Weighted statistic***
Panel v-Statistic	-1,945310 (0,9741)	-6,319432 (1,0000)
Panel rho-Statistic	6,476667 (1,0000)	7,200234 (1,0000)
Panel PP-Statistic	-7,636011 (0,0000)*	-6,076957 (0,0000)*
Panel ADF-Statistic	8,053368 (1,0000)	4,011073 (1,0000)
Group rho-Statistic	9,286256 (1,0000)	
Group PP- Statistic	-6,579796 (0,0000)*	
Group ADF-Statistic	5,781775 (1,0000)	
KAO Co-integration Test	t-statistic	
ADF	-2,856646 (0,0021)*	

Source: Data processing

*Note: * significant at 1 and 5 percent*

The unit root test using weighted average data unit underlines dynamic panel ARDL as a suitable model to investigate this issue (Table 3). The WRB, WIC, WAI, WPO, WED are stationary on level, meanwhile, EG and WHE are stationary on first-difference.

In the next step, this study conducts the co-integration test using the panel co-integration with Pedroni and KAO criteria. This test is used to examine the short-term and long-term relationships on all integrated variables in different orders. The results of all variables (EG, RB, IC, AI, PO, ED, HE) in Table 4 show that they are significant at 1 and 5 percent. It means that there is a strong relationship between all variables in the short-term and the long-term. It denotes that all variables will move towards stable conditions in the long-term. Moreover, lag is determined by the Akaike Information Criterion (AIC) by looking at the smallest value. The lowest lag value obtained is equal to 1. This value is used as the most optimal lag in this study.

Different results are found in the panel co-integration test using weighted average data from independent variables. Based on Table 5, it is evident that there is no significant long-term effect of infrastructure on economic growth in Indonesia.

The result of dynamic ARDL panel regression is depicted in Table 6. The short-term Error Correction Term (ECT) value has a negative slope and a significant effect. It means that this model meets the requirement to explain the effect of physical and social infrastructures on economic growth in Indonesia. Most variables reveal a significant long-term effect such as RBM IC, PO, ED, and HE. However, in the short-term, only RB shows a significant influence. Table 7 represents dynamic panel ARDL regression results using weighted average data of all independent variables. It shows a different result. In the short-run, no variable indicates a significant effect on economic growth. However, in the long-term, most variables (i.e., WRB, WIC, WAI, WED and WHE) show a significant effect on economic growth. The ECT value shows a negative slope and a significant effect, highlighting the capability of this study's model to explain the impact of infrastructures on economic growth.

Roads and bridges variable (RB) has a coefficient and probability of 0.000813 (0.0000), which represents a positive and significant influence on economic growth in the long-term. This condition is also experienced by the WRB variable in the long-term. These results prove the important effect of these variables on economic growth. This finding is also supported by several previous studies (Chakrabarti, 2018; Kumari & Sharma, 2017; Maparu & Mazumder, 2017; Meersman & Nazemzadeh, 2017; Pradhan, 2019; Tong & Yu, 2018). However, the RB variable in the short-term performs the opposite result by a negative coefficient (-0.00512) and significant probability (0.0168). On the contrary, the WRB shows a positive but insignificant coefficient 70.33936 (0.3240), which is consistent with the previous study (Meersman & Nazemzadeh, 2017). This finding denotes that investing in infrastructure has no direct impact on economic growth in the short

Table 6. Dynamic Panel ARDL Regression Results

Variable	Coefficient	t-Statistic	Prob.
Long Run			
RB	0.000813	9.147457	0.0000*
IC	0.001733	5.056504	0.0000*
AI	-0.002444	-1.572547	0.1175
PO	-0.002564	-3.854786	0.0002*
ED	-0.141188	-1.982584	0.0489**
HE	-0.917392	-3.343512	0.0010*
Short Run			
C	2.751701	4.645475	0.0000*
D(RB)	-0.000512	-2.413605	0.0168**
D(IC)	-0.002637	-1.652575	0.1001
D(AI)	-0.052731	-0.923818	0.3568
D(PO)	-0.002448	-0.839873	0.4021
D(ED)	-1.088817	-0.600835	0.5487
D(HE)	-1.525685	-0.370299	0.7116
ECT (-1)	-0.481979	-5.680154	0.0000*

Source: Data processing

*Note: *: significant at 1 percent, **: significant at 5 percent*

Table 7. Dynamic Panel ARDL Regression Results for Weighted Average

Variable	Coefficient	t-Statistic	Prob.
Long Run			
WRB	0.000783	5.312840	0.0000*
WIC	-0.175844	-3.957851	0.0001*
WAI	-9.683684	-7.942185	0.0000*
WPO	0.047587	1.222789	0.2230
WED	0.000021	7.140547	0.0000*
WHE	0.000180	6.837839	0.0000*
Short Run			
C	3.271420	4.832450	0.0000*
D(WRB)	70.33936	0.988916	0.3240
D(WIC)	-21.60299	-1.164350	0.2458
D(WAI)	-87.76813	-0.971705	0.3325
D(WPO)	11.57270	0.672371	0.5022
D(WED)	-0.028196	-0.954942	0.3409
D(WHE)	-1.953270	0.608330	0.5437
ECT (-1)	-0.506352	-6.367297	0.0000*

Source: Data processing

*Note: *: significant at 1 percent, **: significant at 5 percent*

run. Furthermore, the permanent road infrastructure would make the less developed region left behind due to the flow of other products from other regions (Yu et al., 2016). Moreover, the excessive investment in road infrastructure will produce a negative effect on economic growth because of the crowding out capital and the law of diminishing return (Shi et al., 2017).

In addition, the IC variable shows a positive and significant result on economic growth in the long-run. However, the WIC variable indicates negative and significant result in the long-term. This finding is similar to other studies, stating that in low and middle-income countries, the use of irrigation water has a significant effect because most of the economic sectors are related to agriculture (Doungmanee, 2016). Nevertheless, in the short-term, this variable (IC) and weighted variable (WIC) have a negative and insignificant impact on economic growth directly (Meersman & Nazemzadeh, 2017).

The (AI) variable is the only variable that shows a negative and insignificant effect on economic growth, both in the long-term and short-term. Meanwhile, the WAI shows a negative coefficient in the long-run and short-run. But WAI variable has a significant effect on the long-run economic growth. This finding is in line with the previous research (Hakim & Merkert, 2016). It means that there is no two-way causal relationship between GDP and flight activity. Another reason supporting this result is that the multiplier effect of air transportation on economic growth is relatively small (Marazzo et al., 2010). This condition is also caused by the non-optimal use of airport capacity, high operational costs due to the unfriendly environmental energy use, and outdated technology (Khan et al., 2018).

Another view of this study is that port infrastructure (PO) has a negative and significant impact in the long-term, also a negative and insignificant in the short-term on economic growth. The difference in significant level of these variables signifies that investment in infrastructure has no direct impact on economic growth. This indicates that the long-term coefficient (-0.002564) has a higher negative impact than the short-term coefficient does (0.00244). The result of weighted port variable (WPO) also shows the same incident in which the long-run coefficient has a smaller positive value than the short-run coefficient. This reflects negative effects increase in the long-run. The negative impact of port infrastructure on economic growth is caused by more imported goods than exported ones (Cong et al., 2020; Ahmed et al., 2020), or non-optimal use of the capacity. Another cause is that the existence of the port is not aligned with its surroundings market (Miller, 2017), or improper maintenance. Therefore, the operation is inefficient (Dwarakish & Salim, 2015).

Moreover, one of the social infrastructures, i.e., Education (ED), performs a negative coefficient in the long-term and short term but has a different result of significance. The long-term coefficient (-0.141188) is smaller than the short-term coefficient (-1.088817). It denotes that the effect of education on economic growth starts to occur, albeit still has a negative impact. These findings are in contrast with some previous studies (Mariana, 2015; Ogundari & Awokuse, 2018). The reason is that Investment in education takes a very long time to generate an impact on economic activity. In addition, the weighted education variable (WED) yields a similar result to ED. In the short-run, it has a negative coefficient and an insignificant effect, while in the long-run, it possesses a positive coefficient and a significant influence. Therefore, its contribution has not been affected yet (Hamdan et al., 2020) due to a mismatch between the available education access and job needs (Donou-Adonsou, 2019).

Another social infrastructure, i.e., health (HE), also shows a parallel result like education. There is a negative effect in both periods, but at different significant levels. These results differ from most previous studies, which stated that health has a positive and significant relationship with economic growth (Cole, 2019; Gallardo-Albarrán, 2018; Ogundari & Awokuse, 2018). This significant level of difference illustrates that the impact of health infrastructure (SHE) cannot be detected within this short research period or would be proven in a very long period (Neofytidou & Fountas, 2020). The altered coefficient from short-term (-1.525685) to long-term (-0.917392) also illustrates that health infrastructure starts making an impact. The weighted health variable (WHE) also underlines this result that shows a negative and insignificant influence in the short-run, but a positive and significant effect in the long-run. The possible cause is that it happens partly due to the budget allocation, and non-optimal implementation (Akinlo & Sulola, 2019). Another factor is that the total government expenditure in the health sector is only around five percent, and also the lack of private contribution to health service (Lago-Peñas et al., 2013). Another research also highlights that changing attitudes toward health behavior could reduce the effectiveness of health programs, which harms economic growth (La Torre et al., 2019). In addition, high economic growth also contributes to a decrease in mental health due to the increased depression and dissatisfaction (Wang & Granados, 2019).

Finally, this study examines the (ECT) coefficient (Table 6 and Table 7) to specify the stability condition. The ECT (-1) coefficient is (-0.481979) and the ECT (-1) for the weighted model is (-0.506352); this illustrates that if a shock occurs, it takes 5.7 to 6 months to restore the balance condition. In addition, the result of the panel co-integration tests has confirmed that there will be long-term stability as indicated by the level of significance in most of Pedroni and KAO co-integration tests. However, this result does not occur in the weighted model.

CONCLUSION

The results of this study highlight three main points. First, the result of descriptive statistics (see Table 1 and Figure 1) concludes that the inequality of physical and social infrastructures still matters in Indonesia. Using the government expenditure or public investment approach, it is clearly shown that the total investment in the Java's provinces is relatively higher than in other provinces. The only province outside the Java island that has significant higher total investment is the North Sumatra province. Nevertheless, based on the total output of each variable (physical and social infrastructures), the provinces outside Java have the relatively lowest average ratio of total public investment.

Second result of this study, the regression result represents the substantial influence of infrastructure on economic growth in Indonesia. Both in the long-term and short-term, physical infrastructure has a more significant effect than social infrastructure. Almost all variables show a significant impact in the long-run but (AI) which has an insignificant impact. It is understandable because most Indonesians do not use airports due to the expensive cost of economic activities. In addition, the (RB) and (IC) have a positive impact on the long-term economic growth because land transportation is still used as the main way to connect each province in Indonesia, and the agriculture sector is an essential part of Indonesia's economy. Other variables, such as (ED) and (HE), show a negative effect on economic growth because they take a longer time to generate an impact on economic growth based on the weighted average model regression result. These results are also supported by previous studies. Furthermore, most of the variables of this study show a significant effect in the long-term and an insignificant impact in the short-term. It also denotes that the weighted roads and bridges variable (WRB) has the most substantial positive coefficient reflecting its important role in economic activity.

These results are also supported by the World Education News + Reviews (Dilas et al., 2019). Their findings are consistent with the results of this study in which Indonesia still strives to provide inclusive and high-quality education despite a lot of money spent on public education. Furthermore, although education reform has been carried out since mid-2000, the literacy level, tertiary attainment level, and outbound student mobility are still dwarfed compared to other Southeast Asian Nation (ASEAN) countries. Hence, more substantial effort will be required to overcome this issue. This finding also highlights that social infrastructure, such as education, requires a more comprehensive study to obtain an in-depth analysis. Such studies are important for the government in formulating their policy with regard to this issue.

Third, the ECT (-1) result and panel co-integration tests reveal that there will be short-term and long-term stability conditions, although the weighted model fails to justify long-term stability of all observed variables. The government and authorized stakeholders should conduct studies on this issue in more depth to determine the most suitable infrastructure for each province as a way to support its economic growth. Furthermore, further researchers are suggested to conduct comprehensive research on physical and social infrastructures by taking different approaches and including other variables that can describe more comprehensive development outcomes.

LIMITATION

It is worth noting that this study has some limitations. Local government expenditure and other expenditure infrastructure schemes, such as public-private partnerships, are not included. This could lead to an incomplete overall infrastructure expenditure. The budget for social infrastructures, such as education and health, in this study, is the total government expenditure in the sector, including employees, operations, capital expenditure, and social assistance. Further research should differentiate them in detail. Therefore, further studies using more detailed data related to the infrastructure budget are necessary, especially for these two social infrastructure variables. It also needs to consider the provincial population in the dynamic model to produce a more comprehensive discussion regarding this topic.

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