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Infrastructure Development and Economic Growth in Indonesia: A Province Panel Data Analysis

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Infrastructure development is considered as a factor that promotes development. On the other side, inequality in infrastructure development can cause economic growth disparity. This study aims to investigate the impacts of infrastructure development on economic growth disparity across provinces in Indonesia that today consists of 34 provinces. The data used came from the Indonesia Database for Policy and Economic Research (INDO-DAPOER) of the World Bank. The analysis employed the random effects regression model for panel data. The dependent variable was GDP per capita without oil and gas (constant price, million rupiah), while the independent variables were household access to electricity (total in % of total household), literacy rate for population age 15 and over (in % of total population), and birth attended by skilled health worker (in % of total birth). The results of the study show that higher economic growth is associated with better infrastructure development, that is higher household access to electricity, higher literacy rate for population age 15 and over, and higher birth attended by skilled health worker. Disparity in economic growth across provinces was also indicated by the difference in constant for each province in the model.

Key words: *Infrastructure, Economic gowth, Regional diparities, Panel data, Indonesia.*

JEL Code: A12, B11, C33, H54

Introduction

All factors that have an impact on economic growth are called total factor productivity (TFP). TFP is the central analysis of economic growth. Employing the aggregate production function, the economy estimates economic growth that is explained by the increase in capital, labor (Hulten et al. 2013; Romer 1994), including infrastructure (Esfahani and Ramírez 2003), international trade and creative economics (Rajagukguk, W., 2016; Samosir, O.B., 2016)

Calderón et al. (2018) carried out a research and found that efficiency in infrastructure spending can augment multiplier output from spending that later has an impact on economic growth in Sub Saharan. Included in TFP are investment and the results of investment in health, education, and infrastructure development by the government, such as household access to electricity, literacy rate for population age 15 and over, and birth attended by skilled health worker.

The enhancement in electricity consumption promotes industrial economy progress (Shao 2017). The impact of electrification on growth and economic development is an interesting study. Electrification is a factor of TFP that can foster economic growth from various sides.

Gertler et al. (2017) studied the effects of electrification in urban areas. The improvement of economic development level can be achieved through the expansion of access to electricity. Taheruzzaman and Janik (2016) found that the enhancement of energy consumption played a role in the increasing of income per capita by between US$1,000 and US$10,000, and an economic growth in Bangladesh. Meanwhile, Kirubi et al. (2009) found that rural electrification contributed to rural economic development in Kenya. Access to electricity simultaneously enables and improve rural infrastructure, such as school, market, and water pump that can increase agriculture activity productivity. Further, it was also found that local electrification users have capacity to determine rural commodity tariff that later generates income improvement. Furthermore, Shiu and Lam (2004) examined causal relationship between electricity consumption and real GDP in China during 1971–2000. Their estimation showed that electricity consumption had an impact on real GDP, but not otherwise.

Barro (2001) emphasized the role of education on economic growth. Education is measured by the years of schooling attainment. The relationship between education, both formal and informal, and economic growth has been an economic debate as social science discipline. A number of studies, approaches, and models have been developed to explain this relationship complexity (Cheek et al. 2015). The role of education improvement as a central of development strategy, although in the short run education expansion does not directly improve economic condition.

Hanushek and Wössmann (2007) conducted an empirical study on how the cognitive skill of people, rather than school attainment, is strongly related to individual income, income distribution, and economic growth.

International comparison shows that disparity in cognitive skill is greater than school enrolment dan attainment in developing countries. Higher education level has laid knowledge foundation that has resulted in technological progress for a sustainable growth for more than two last centuries. Training and education of the labor force has enabled the utilization of technology in economic production. It becomes clearer to the economists that the quality of the labor force is a driver of economic growth (Salle 2010).

Further, Barro and Lee (1994) proposed that lower initial real per-capita GDP grows faster because of education achievement and health. In addition, Desai (2012) found that literacy rate can be an economic solution of socioeconomic problems, such as employment, underemployment, poverty, and unequal distribution of wealth being. Literacy rate can also reduce economic disparity and income gap.

Studies on the impacts of literacy rate on economic growth and population growth show that each of these three factors is associated with one another. Literacy rate is a key indicator of economic situation. Literacy rate promotes human capital improvement in India. Literacy rate also provides better employment opportunity prospect and gives higher socioeconomic status. The increase in literacy rate also has an impact on population growth rate.

Across countries, health is related to income per capita. Health can be measured by the life expectancy at birth and maternal health (Weil 2014). There is a two-way causality between health and economic growth. Healthier individuals are more productive, study better at school, and because they live longer, it allows incentive on human capital accumulation.

On the other side, individuals with higher income improve their health in various ways, from better nutrition to public health infrastructure construction development. The outcome of income increase and health improvement is institutional quality enhancement at country level and human capital development at individual level. Health is a main human welfare resource and also an instrument of income improvement. There is a number of mechanism how health affects income, such as through worker productivity, children education, saving and investment, demographic structure, and morbidity status that can affect lifespan (Bloomand Canning 2008). Health improvement, in particular maternal health, can be enhanced through trained birth attendance.

To reduce maternal mortality, specifically in developing countries, the foremost focus is done in two things: train and empower birth attendants and improve delivery facilities (Prata 2011,

Samosir et al. 2020). The primary effort in community training helps delivery and provides technology, such as misoprostol, family planning, measurement of blood loss, and postpartum care, and will improve economic welfare opportunity among world's lowest economic quintile and also will be beneficial for safe motherhood effort. Ahmed et al. (2010) analyzed the results of the Demographic and Health Surveys in 31 developing countries employing a number logistic regression. They found that modern contraceptive use, antenatal care, and skilled birth attendance had positive impacts on economy, education, and women's empowerment status.

Based on the above discussion, this study aims to examine the impacts of infrastructure development on economic growth in Indonesia. The infrastructure development includes education, health, and electricity.

Data and Methods

Data

The data used in this study came from the Indonesia Database for Policy and Economic Research (INDODAPOER) of the World Bank[1]. The data were accessed on December 12th, 2019. The unit of analysis is the provinces in Indonesia. The observation period is 2001–2012 that covered 33 provinces of Indonesia during that time.[2] Therefore, there were 396 observations in the analysis.

The dependent variable in the analysis was the GDP per capita without oil and gas (constant price, million rupiah) (GDP). The independent variables were the household access to electricity (total, in % of total household) (Electricity), literacy rate for population age 15 and over (in % of total population) (Literacy), and birth attended by skilled health worker (in % of total birth) (Birth).

Methods

A random effects regression model for panel data was employed to study the impacts of infrastructure development in Indonesia. The model is as follows (Woolridge 2002).

$$Y_{it} = \beta_1 . X_{1,it} + ... + \beta_k . X_{2.it} + \alpha_i + u_{ii} \quad \text{..... .....} \quad (1)$$

[1] https://datacatalog.worldbank.org/dataset/indonesia-database-policy-and-economic-research

[2] In 2012 the number of provinces in Indonesia became 34. North Kalimantan province was still part of East Kalimantan in this study.

$i = 1,...,n$ is the entity, $t = 1,...,T$ is time, $\alpha_i (i = 1,...,n)$ is the entity-specific intercepts that captures heteroginity across entity, Y_{it} is the dependent variable, X_{it} represents an independent variable, β_1 is the coefficient of the *k*-th independent variable, u_{ii} is the error term.

The equivalent representation of this model can be written as follows.

$$Y_{it} = \beta_0 + \beta_1.X_{1,it} + ... + \beta_2.X_{2.it} + \gamma_2.D2_i + ... + \gamma_2.Dn_i + \mu_i \quad \text{..... (2)}$$

D2, D3, … and D33 are the dummy variables for the provinces.

Results

The summary statistics of the variables in the model (number of observations, mean, standard deviation, minimum, and maximum values) are presented in Table 1. It can be seen that the economic achievement and infrastructure development varied greatly across provinces in Indonesia. GDP per capita without oil and gas (constant price, million rupiah) varied between 1.8 and 43.2. Household access to electricity (total, in % of total household) ranged from 36.2 to 100.0 (universal). Literacy rate for population age 15 and over (in % of total population) varied between 64.1 and 99.3 (almost universal). Birth attended by skilled health worker (in % of total birth) ranged from 27.9 and 99.3 (almost universal).

Table 1: Summary statistics (number of observations (*n*), mean, standard deviation, minimum, and maximum values) of the variables in the model

Variable	*n*	**Mean**	**Standard deviation**	**Minimum**	**Maximum**
GDP per capita without oil and gas (constant price, million rupiah)	396	7.312207	6.560	1.7589	43.1954
Household access to electricity: (total, in % of total household)	396	81.80682	15.569	36.2	100.0
Literacy rate for population age 15 and over (in % of total population)	396	92.04975	6.183	64.1	99.3
Birth attended by skilled health worker (in % of total birth)	396	69.72475	16.943	27.9	99.3

Source: INDODAPOER (2019) (Authors' calculation).

The results of Hausmann test of the appropriate model, between random effects and fixed effects, show that the appropriate model is the random effects model. The coefficient, standard error, *t*-statistic, and *P*-value of the random effects model of the determinants of economic growth in Indonesia in 2001–2012 are given in Table 2. It can be seen that all infrastructure development factors have positive effects on economic growth significantly statistically. Therefore, nationally the econometric model can be written as follows.

GDP = -1.5591 + 0.0104Electricity + 0.0258Literacy + 0.0015Birth

Household access to electricity was significant at the less than 0.001 significance level. Other things being the same, an increase of one percent in household access to electricity (total, in % of total household) will increase GDP per capita without oil and gas (constant price, million rupiah) by 0.010446. In this study, household access to electricity was the first strongest factor of GDP.

Literacy rate for population age 15 and over was also significant at the less than 0.001 significance level. Ceteris paribus, an increase of one percent in literacy rate for population age 15 and over (in % of total population) will increase GDP per capita without oil and gas (constant price, million rupiah) by 0.025831. In this study, literacy rate for population age 15 and over was the second strongest factor of GDP.

Birth attended by skilled health worker was also significant at the 0.005 significance level. After controlling for the effects of other factors, an increase in one percent of birth attended by skilled health worker (in % of total birth) will increase GDP per capita without oil and gas (constant price, million rupiah) by 0.001508. In this study, birth attended by skilled health worker was the third strongest factor of GDP.

Table 2: Coefficient, standard error, *t*-statistic, and *P*-value of the random effects model of the determinants of economic growth, Indonesia 2001–2012

Variable	**Coefficient**	**Standard Error**	**t-Statistic**	***P*-value**
Constant	-1.559110	0.290213	-5.372301	0.0000
Household access to electricity	0.010446	0.000755	13.83107	0.0000
Literacy rate	0.025831	0.003540	7.296687	0.0000
Birth attended by skilled health worker	0.001508	0.000598	2.523708	0.0120

Source: INDODAPOER (2019) (Authors' calculation).

The results of the random effects regression model for panel data show disparities in economic growth across provinces. It is indicated by the difference in the constant of the model for each province as displayed in Table 3.

Table 3: Constants for provinces in the fixed effects model of the determinants of economic growth, Indonesia 2001–2012

No.	Province	Constant
1	Bali	0.018488
2	Banten	-0.100728
3	Bengkulu	-0.380112
4	DI Yogyakarta	-0.194848
5	DKI Jakarta	1.440704
6	Gorontalo	-0.909888
7	Jambi	-0.363729
8	Jawa Barat (West Java)	-0.172743
9	Jawa Tengah (Central Java)	-0.349498
10	Jawa Timur (East Java)	0.212219
11	Kalimantan Barat (West Kalimantan)	0.215045
12	Kalimantan Selatan (South Kalimantan)	0.053326
13	Kalimantan Tengah (Central Kalimantan)	0.180533
14	Kalimantan Timur (East Kalimantan)	0.747831
15	Kepulauan Bangka Belitung (Bangka Belitung Island)	0.139722
16	Kepulauan Riau (Riau Island)	1.066111
17	Lampung	-0.286972
18	Maluku Utara (North Maluku)	-0.758261
19	Maluku	-0.880154
20	Aceh	-0.214155
21	Nusa Tenggara Barat (West Nusa Tenggara)	-0.127030
22	Nusa Tenggara Timur (East Nusa Tenggara)	-0.313238
23	Papua Barat (West Papua)	0.253795
24	Papua	1.370399
25	Riau	0.095071
26	Sulawesi Barat (West Sulawesi)	-0.284561
27	Sulawesi Selatan (South Sulawesi)	0.029183
28	Sulawesi Tengah (Central Sulawesi)	-0.041105
29	Sulawesi Tenggara (Southeast Sulawesi)	-0.120458
30	Sulawesi Utara (North Sulawesi)	-0.069217
31	Sumatera Barat (West Sumatera)	-0.015559
32	Sumatera Selatan (South Sumatera)	-0.112787

33	Sumatera Utara (North Sumatera)	-0.127386

Source: INDODAPOER (2019) (Authors' calculation).

Conclusions

Total factor productivity (TFP) represents all factors that can be utilized to develop economy. Every country has a number of channels in developing its economy. Among TFP is household access to electricity, literacy rate for population, and birth attended by skilled health worker. The results of this study confirm the importance of this infrastructure development has impacts on economic growth in Indonesia both nationally and provincially. In addition, there is disparity in economic growth across province in Indonesia.

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