
DETERMINANTS OF INFRASTRUCTURE SPENDING EFFICIENCY IN INDONESIA: DATA ENVELOPMENT ANALYSIS (DEA) AND TOBIT REGRESSION APPROACH

Sri Hartono¹, Aulia Fuad Rahman², Muhammad Tojibussabirin³

Universitas Brawijaya, Malang, Indonesia

hart_3011@student.ub.ac.id¹, fuad_ub@ub.ac.id², sabirin@ub.ac.id³

ABSTRACT

This study aims to measure the efficiency value of the Ministry of PUPR's infrastructure development in each province in the 2020-2022 period and examine the influence of the determinants of efficiency through fiscal capacity, population, and area. The data used in this study uses secondary data, namely expenditure realization data in the PUPR Ministry's financial reports, Minister of Finance Regulations regarding regional fiscal capacity, and data on population and area according to the Central Bureau of Statistics. This study uses two stages of analysis; the first is to measure technical efficiency with the DEA approach through the assumption of input-oriented VRS (Variable Return to Scale), and the second is to analyze the determinants using the Tobit regression model. The study results show that the average infrastructure development efficiency score decreased over 2020-2022. Other results find that fiscal capacity has an effect on increasing the efficiency of infrastructure development, and population size and area have an effect on reducing the efficiency of infrastructure development.

Keywords: efficiency, infrastructure development, fiscal capacity, population, area.

Corresponding Author: Sri Hartono

E-mail: hart_3011@student.ub.ac.id



INTRODUCTION

Infrastructure provision is one of the strategic choices to accelerate Indonesia's economic growth and equity (Gunawan & Maryoni, 2017). The government needs to accelerate the program for proportional distribution of development in all regions. Thus, the development process that occurs is biased in already advanced areas and other areas considered to be lagging (Sukwika, 2018).

Every infrastructure development expenditure is hoped to support and facilitate economic activity. Previous research has shown that the realization spending spent on public infrastructure development has a positive role in social welfare and economic growth (Luter et al., 2019), (Ramadhan, 2019), (Ramírez & Vargas, 2018).

The State Revenue and Expenditure Budget for 2020-2022 stipulates that infrastructure spending will receive an allocation of 22% of the total APBN, one of which is aimed at supporting the national economic recovery program through infrastructure development under the National Medium Term Development Plan (RPJMN) 2020-2024. In the 2020-2024 RPJMN, the need for infrastructure spending is estimated at IDR 6.445 trillion, while the APBN is only 37% or IDR 2.385 trillion in financing infrastructure development.

The limited budget that is owned requires the government to be more efficient in managing infrastructure development spending. However, based on previous research, it is known that local government spending in Indonesia in 2015 - 2018 has yet to reach a good level of efficiency (Rambe,

2020). There are 20 provinces (58.8%) that are inefficient, nine provinces (26.5%) are relatively efficient in certain years, and only five provinces (14.7%) are always efficient. Nationally, the level of spending efficiency in Indonesia's infrastructure sector has an average value of 61.9%. This efficiency level is below Malaysia, with an average value of 73.6%, and Singapore and Thailand, with an average of 100% (Merini, 2013). The Ministry of Finance, through a study related to the efficiency of infrastructure spending at the Ministry of Public Works and Public Housing, the Ministry of Transportation, and the Ministry of Energy and Mineral Resources, stated that only two provinces (West et al.) were the most efficient (Negara, 2013).

Efficiency is one of the main elements (besides economy and effectiveness) in the concept of value for money when measuring the performance of public sector organizations (Erawan et al., 2018). Efficiency is using as few resources as possible to get maximum results (maximizing benefits and minimizing costs) (Mardiasmo, 2021). In implementing the New Public Management (NPM), efficiency is emphasized in all government organizations as a measure of the performance of government organizations. Ministries/Institutions are directed to improve the quality of spending that is more efficient but has an optimal impact on the economy and people's welfare under government policy steps contained in financial notes along with the state budget and income (Finance, 2021).

The Ministry of Public Works and Public Housing, as one of the government institutions responsible for infrastructure development in Indonesia, has to continue to improve the reliability of public works and public housing infrastructure, which consists of the water resources sector, the high-level development sector, and the creative works sector. In 2020 the Ministry of PUPR managed a budget of IDR 107.1 trillion; this amount increased by 50.6% in 2021 to IDR 161.3 trillion and decreased by 16.5% in 2022 to IDR 135.4 trillion. Accountability for relatively large budget management is an important thing for the Ministry of PUPR to do. Management of this large budget is expected to be able to fulfill aspects of good efficiency so that spending sourced from state debt financing becomes meaningful in overcoming infrastructure gaps which ultimately leads to the goal of building economic growth.

Based on the background that has been explained, this research was conducted aiming to evaluate the efficiency of infrastructure development carried out by the Ministry of Public Works and Public Housing during the 2020-2022 period and to examine the factors that influence the efficiency of infrastructure spending in supporting economic growth in all provinces in Indonesia. This research adapts previous research in analyzing the efficiency of government capital spending on economic development in Aceh Province (Chandra et al., 2022). Other research also examines the effect of fiscal capacity on the efficiency of local government spending in provinces throughout Indonesia (Rambe, 2020). The differences in this research from previous research are. First, this research looks at it from the point of view of the central government in realizing infrastructure development spending. Second, measuring the efficiency level using capital expenditure and maintenance input variables. Third, this study adds the independent variables of population and area as factors that influence the efficiency of government spending.

METHODS

This study uses a quantitative approach in which data is in the form of numbers or numbers that can be processed and analyzed using statistical techniques (Bougie & Sekaran, 2019). Quantitative research can be used to explain and predict certain conditions so that overall conclusions can be drawn.

The population in this study are all provinces where the Ministry of Public Works and Public Housing realized spending on infrastructure development in the Highways, Cipta Karya, and Water Resources sectors in 2020-2022. Sampling in this study was by using a census, where all population members were used as samples, so the number of samples used in this study was 34 provinces.

This research uses secondary data for 2020-2022 in fiscal capacity obtained through a Minister of Finance Regulation issued annually by the Ministry of Finance. Data on the realization of capital and maintenance expenditures per sector were obtained from the Financial Report of the Ministry of PUPR. Data on per capita gross regional domestic product, population, and area based on the Central Bureau of Statistics are accessed via www.bps.go.id.

This study has two stages of analysis, namely an analysis of the technical efficiency value of infrastructure development spending during the 2020-2022 period measured using the DEA model BCC (Banker et al.) approach through the input-oriented VRS (Variable Return to Scale) assumption using MaxDEA software assistance. Lite v12.0. The measurement of efficiency in this study uses the input variable to realize capital expenditure and maintenance in the water resources, high school, and creation sectors. In contrast, the output variable is Gross Regional Domestic Income per capita. In the second stage, the effect of fiscal capacity, population, and area on technical efficiency was tested using the Tobit regression model with the help of EViews 10 software. Tobit regression was used because the dependent variable data is censored in efficiency scores ranging from 0 to 1.

RESULTS AND DISCUSSION

Efficiency Analysis based on DEA

The first stage of this research is to measure the technical efficiency of the Ministry of PUPR's infrastructure spending in each province through input and output using Data Envelopment Analysis (DEA) through the input-oriented Variable Return to Scale (VRS) approach using MaxDEA Lite v12.0 software. A province is considered technically efficient with an efficiency score of 100%.

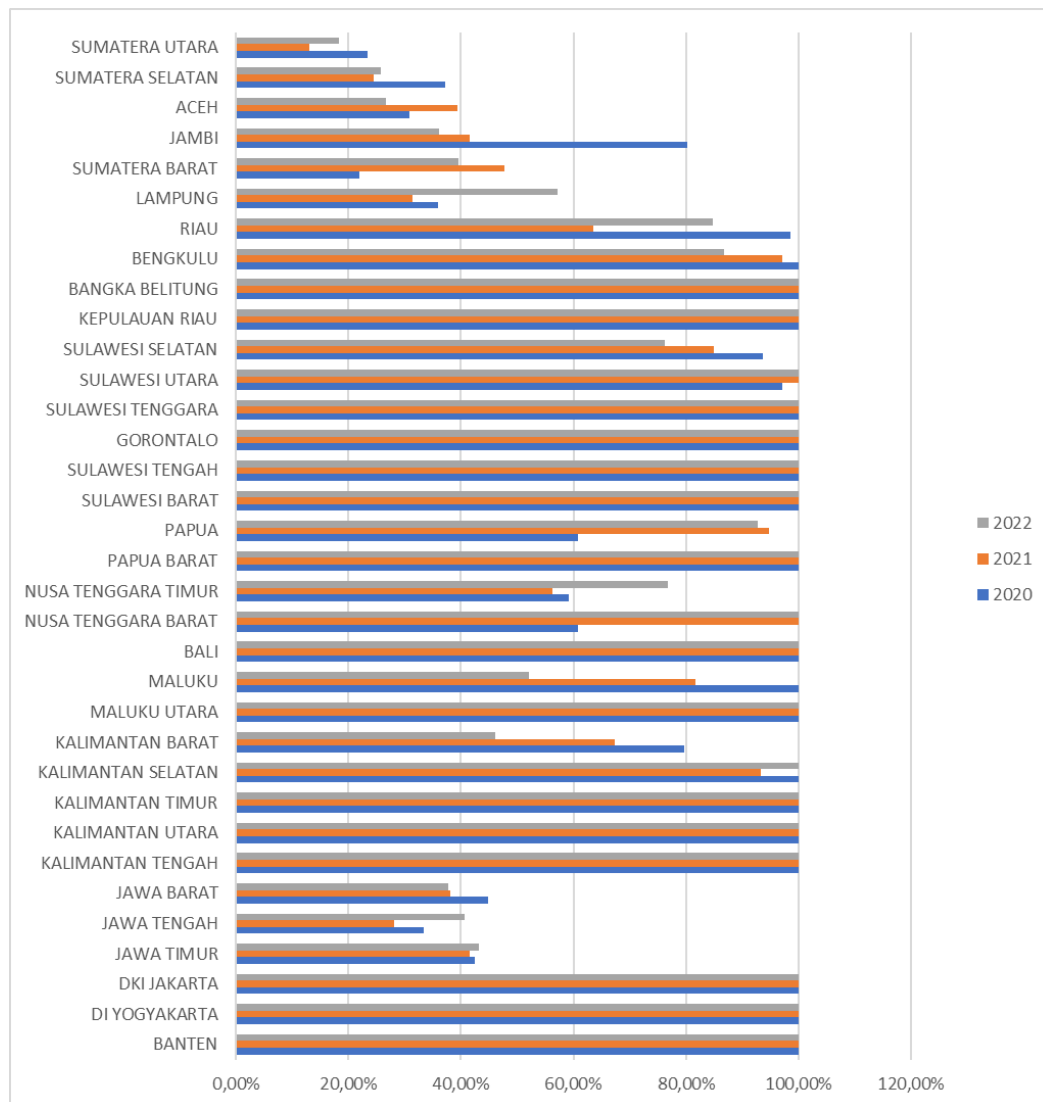


Figure 1. Graph of efficiency for the 2020-2021 period

Source: Processed data, 2023

Figure 1 shows the number of efficient provinces from 2020 to 2022 has fluctuated. In 2020 there are 18 provinces or 52.94% efficient (DI Yogyakarta, DKI Jakarta, Banten, North Kalimantan, East Kalimantan, Central Kalimantan, South Kalimantan, North Maluku, Maluku, Bali, West Papua, West Sulawesi, Central Sulawesi, Southeast Sulawesi, Gorontalo, Riau Archipelago, Bengkulu, Bangka Belitung). In 2021 there are 17 provinces or 50% efficient (DI Yogyakarta, DKI Jakarta, Banten, North Kalimantan, Central Kalimantan, East Kalimantan, North Maluku, Bali, West Nusa Tenggara, West Papua, West Sulawesi, Central Sulawesi, Gorontalo, Southeast Sulawesi, North Sulawesi, Riau Archipelago, Bangka Belitung). In 2022 it increased to 18 provinces or 52.94% efficient (DI Yogyakarta, DKI Jakarta, Banten, North Kalimantan, East Kalimantan, Central Kalimantan, South Kalimantan, North Maluku, Bali, West Nusa Tenggara, Papua, West Papua, Sulawesi North, West Sulawesi, Central Sulawesi, Gorontalo, Southeast Sulawesi, Riau Archipelago, Bangka Belitung,). The province with the lowest efficiency score (22.03%) in 2020 is South Sumatra Province; in 2021, the

lowest efficiency score (13.00%) is North Province, while in 2020, the lowest efficiency score (18.27%) is North Sumatra Province.

Results of Tobit Regression Analysis

Testing the hypothesis in this study on the Tobit regression model was carried out using the Likelihood Ratio Test and the Wald Test with the Eviews10 application. The Likelihood Ratio test tests whether one or all of the independent variables have a real contribution to the dependent variable. The Wald test shows the significance value of the influence of one independent variable in explaining the variation of the dependent variable, which assumes that the other independent variables are unchanged (constant).

Likelihood Ratio Test

The test results were carried out using the Eviews program, as shown in Table 1. Based on the test results, the Likelihood Ratio value was 59.74547 with a probability level (α) of 0.0000. So it can be concluded that overall the independent variables (fiscal capacity, population, and area) affect the dependent variable (Technical Efficiency) because the Likelihood Ratio value $>$ chi-square ($\chi^2 = 7.815$) and the probability value is less ^{than} 0.05.

Table 1. Likelihood Ratio Test Results

	Value	df	probability
	59/74547	3	0.0000
LR test summary:	Value		
Restricted LogL	-59.01438		
Unrestricted LogL	-29.14165		

Source: Processed data, 2023

Wald's test

Criteria for decision-making to accept or reject the hypothesis can be done by looking at the probability number (α) or p-value and the direction of the variable coefficient value (positive/negative). If the number probability (significance) $\alpha < 5\%$, then the hypothesis is accepted. The hypothesis is rejected if the number probability (significance) $\alpha > 5\%$. The following is the analysis results using tobit regression with Eviews10 software.

Table 2. Significance Test Results

Variables	coefficient	std. Error	z-Statistics	Prob.
FIS	0.308973	0.080765	3.825573	0.0001
PEN	-0.647676	0.077408	-8.367031	0.0000
WIL	-0.131296	0.054346	-2.415941	0.0157
C	3.537173	0.381075	9.282097	0.0000

Source: Processed data, 2023

The Effect of Fiscal Capacity on the Efficiency of Infrastructure Development Spending

The test results through the Eviews program shown in Table 2 show that the coefficient value of the FIS variable (positive) is 0.308973, and the significance is at the 0.0001 level. These results mean that fiscal capacity positively affects the efficiency of infrastructure development. The better the regional fiscal capacity has the potential to increase the efficiency of infrastructure development spending carried out by the Ministry of PUPR. The higher the fiscal capacity of a region, the fewer

APBN resources are realized by the Ministry of Public Works and Public Housing in carrying out infrastructure development to support economic growth in certain provinces.

The results of research on fiscal capacity's effect on infrastructure development's efficiency align with the research conducted (Rambe, 2020). Fiscal capacity has a positive and significant effect on the efficiency of government spending in 34 provinces in Indonesia (Rambe, 2020). Similar statements are also proven by previous studies on research related to factors affecting government performance in Portugal (Da Cruz & Marques, 2014).

Provinces with good fiscal capacity should be able to finance infrastructure development in their territory. This can be used as a consideration for the Ministry of PUPR in conditions of limited infrastructure development budgets to allocate infrastructure development spending in each province. This research provides evidence of the need for coordination between the central government and local governments in infrastructure development to improve a province's economy. This coordination allows the central government to use the available budget more efficiently.

The Effect of Area on the Efficiency of Infrastructure Development Spending

The test results in Table 2 show that the coefficient value of the PEN variable (negative) is 0.647676 and has significance at the 0.00000 level. These results indicate that the population harms the efficiency of infrastructure development. This implies that the more the population will increase the need to meet infrastructure for all people in a province. During 2020-2022 the population will always increase, followed by the amount of actual infrastructure development spending in each province, but not all provinces will experience an increase in GRDP. This condition illustrates that the level of efficiency in infrastructure spending is getting smaller because high infrastructure investment is not followed by increased economic growth in each province.

The results of this study are supported by several previous studies, which stated that in 31 provinces in China, they found a significant effect of population on the efficiency of government spending. A similar statement is also proven by research related to the performance evaluation of public sector spending conducted in 18 OECD countries during the 1995-2002 period that population size negatively influences the efficiency of public sector spending in the health sector (Hsu & Lee, 2014).

Concerning the contingency theory, the results of this study prove that population size should be an organizational consideration as a contingency factor in investing in infrastructure development in a province. Efficiency in spending on infrastructure development can be achieved if infrastructure provision can support people's productivity in each province. So that in making investment decisions for infrastructure development, it is necessary to pay attention to external environmental factors of the population.

The Effect of Area on the Efficiency of Infrastructure Development Spending

The test results presented in Table 2 show the coefficient value of the WIL variable (negative) of -0.131296 and significance at the 0.0157 level. These results indicate that the area harms the efficiency of infrastructure development. The total area of a province can affect the need to provide adequate public facilities and infrastructure. If the province area is wider, it will cause the distance between locations to be farther apart, so the need for accessibility for the community to public facilities is getting higher.

Provinces with a large area tend to have diverse geographical, natural conditions, such as mountains and hills valleys, rivers, or lakes. The diversity of natural conditions can potentially affect the efficiency level of infrastructure spending. Infrastructure development in hilly areas certainly requires a more complex design and higher costs compared to lowland areas.

The results of this study are supported by several previous studies, which state that area has a significant negative effect on the efficiency of government spending in Indonesia AD (Prasetyo et al., 2018). The determinants affecting government performance in Portugal conclude that the area harms the efficiency of government spending (Da Cruz & Marques, 2014). This study's results align with previous studies in Japan, which stated that the area has a negative effect on the efficiency level of Nakazawa (2014).

The area size factor is important as one of the considerations for investment in infrastructure development in each province. Some regions have rich natural resource potential, while others may have advantages in tourism or other industries. So, to achieve efficiency in infrastructure development in certain provinces, the infrastructure development must encourage economic growth, maximize existing potential, and strengthen connectivity between regions.

CONCLUSION

Regions with high fiscal capacity can better finance infrastructure provision in their regions and are less dependent on the central government's APBN. This will have an impact on the efficiency of spending on infrastructure development because there are fewer input resources in the form of expenditure realization using the APBN at the Ministry of Public Works and Public Housing, which is used for infrastructure development in the province. An increase in population will reduce the level of efficiency of infrastructure development. The more population will increase the need to meet infrastructure for the whole community. The increase in infrastructure needs will have an impact on increasing costs which will ultimately affect the level of efficiency. The factor of the province's area can reduce the efficiency of infrastructure development. The territory of a province has geographical characteristics that are different from one another. The wider the province tends to have different geographical, natural conditions. Infrastructure development in difficult geographical conditions such as hills requires a more complex design and higher costs than in lowland areas.

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