

The Influence of Local Government Spending Efficiency on Human Development in Indonesia

Putri Maziya Ikhsanti¹, Candra Fajri Ananda¹

¹Fakultas Ekonomi dan Bisnis, Universitas Brawijaya, Indonesia

*Corresponding Author: Putri Maziya Ikhsanti

e-mail: mazyaputri26@gmail.com



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Abstract

This study aims to measure the efficiency of local government spending in improving human development across 34 provinces in Indonesia during 2015–2024, and to identify the factors influencing efficiency. A two-stage approach is employed, consisting of Data Envelopment Analysis (DEA) and Tobit regression. The results show that the average efficiency of provincial spending fluctuates and has not yet reached full efficiency. Several provinces such as the Riau Islands, the Special Region of Yogyakarta, the Bangka Belitung Islands, Maluku, and North Kalimantan reached relative efficiency (score = 1) in multiple years, whereas Central Java and East Java tended to record low efficiency scores. The Tobit estimates indicate that GRDP per capita and population density have a positive and significant effect on efficiency, while the poverty rate has a negative and significant effect. These findings confirm that improving human development depends not only on the size of public spending, but also on provinces ability to convert public expenditures into human development outcomes, which is shaped by fiscal capacity, social conditions, and the spatial structure of regions.

Introduction

In 1990, the United Nations Development Programme (UNDP) introduced the term human development as a fundamental issue in development economics, a key focus to this day. The global development paradigm has shifted from economic growth to human development, providing greater opportunities for people to participate in development processes and policymaking (Kurniawan & Murtala, 2021). At the national level, human development issues have also become increasingly important, particularly at the regional level. This is because most regional governments still focus on physical development and infrastructure, while sectors that directly contribute to improving human resources, such as education and health, are often under-priority (Kurniawan & Murtala, 2021). Yet, a country's development success is determined not only by its income or GDP, but also by its population's quality of life, as reflected in indicators such as life expectancy, education, and purchasing power (Widodo & Waridin, 2011).

One of the main indicators for measuring the quality of human development is the Human Development Index (HDI), which represents three main dimensions: (1) a long and healthy life, (2) knowledge, and (3) a decent standard of living (BPS, 2025). The Human Development Index was developed to emphasize that the success of development is not only measured by economic growth, but also by the extent to which people have the opportunity to live healthily, be educated, and have access to resources for a decent life (UNDP, 1990). In line with this, data from the Central Statistics Agency shows that Indonesia's HDI nationally continues to increase from year to year. In 2024, Indonesia's HDI reached 75.02, up from 74.39 in 2023

(BPS, 2024). This increase indicates an improvement in the quality of life of the community, although equality between regions remains a challenge.

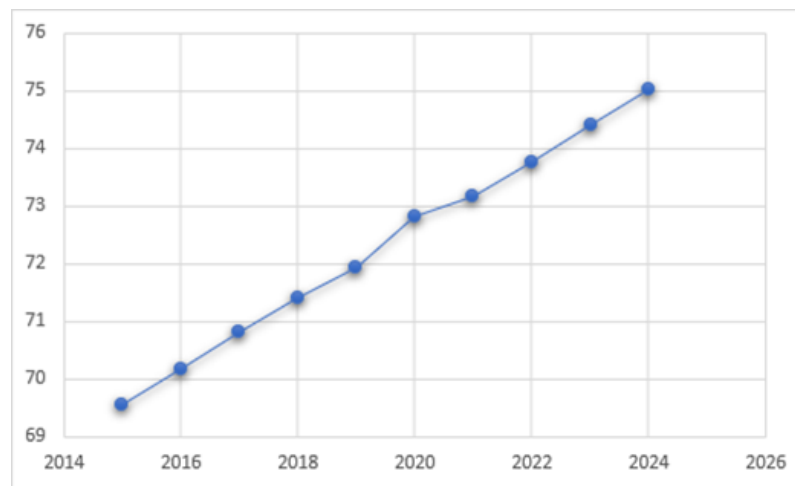


Figure 1. National Human Development Index (HDI) Trend (2015–2024)

Source: Central Statistics Agency (Processed by researchers)

Although Indonesia's Human Development Index (HDI) has shown an upward trend over the past 10 years, Indonesia's regional position still lags behind several ASEAN countries. Indonesia's 2022 HDI achievement ranked 112th (0.713), while Brunei Darussalam ranked 55th (0.823), Malaysia ranked 63rd (0.807), and Thailand ranked 66th (0.803) (UNDP, 2022). This indicates that Indonesia's human development quality still needs to be improved to reach parity with other Southeast Asian countries.

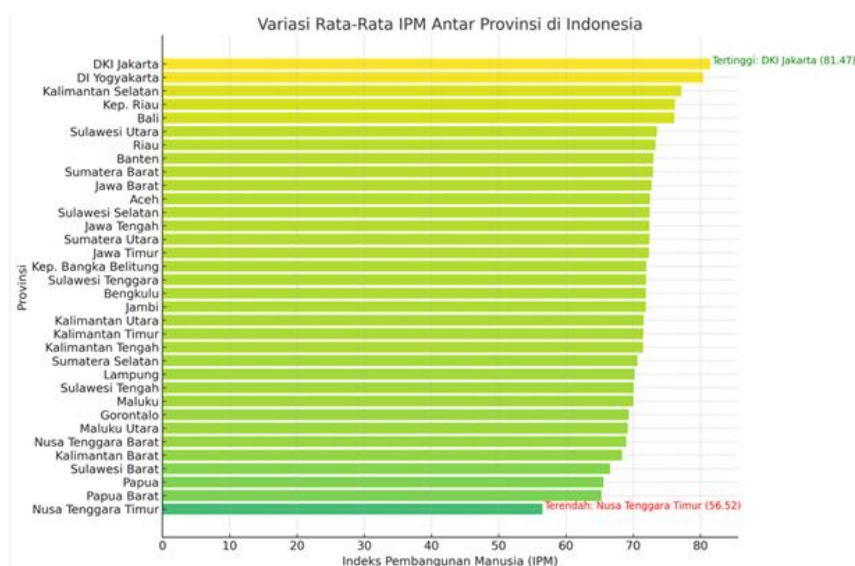


Figure 2. Average HDI per Province in Indonesia (2019-2024)

Source: Central Statistics Agency (Processed by researchers)

The national HDI is essentially the aggregated result of each province's achievements, which is highly dependent on the effectiveness of fiscal resource management within the region. Disparities between regions are evident; for example, DKI Jakarta recorded an HDI of 84.15, while East Nusa Tenggara recorded 56.52, resulting in a difference of approximately 27.63 points. In terms of decentralization, regional governments play a crucial role because they manage a large portion of basic service spending approximately 72% of health spending and

65% of education spending. More than half of total government spending (excluding subsidies and interest) is handled by regional governments. Therefore, improving the HDI depends not only on budget size but also on the efficiency of regional spending, particularly in the education, health, and economic sectors, to accelerate HDI growth while reducing disparities between regions.

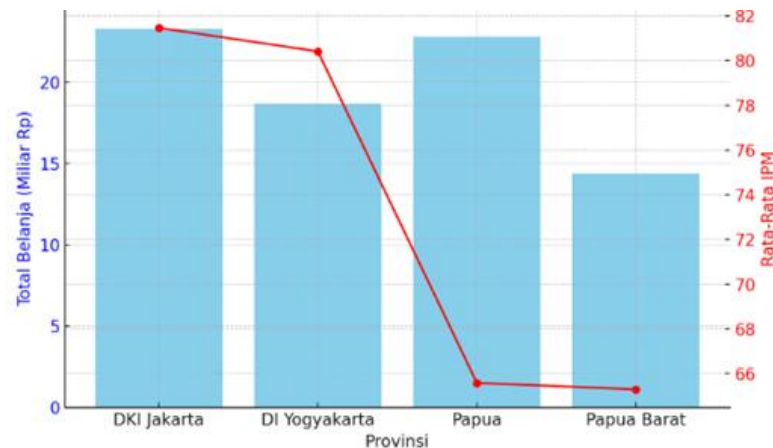


Figure 3. Comparison of Regional Spending and Human Development Index Relationship Patterns

Source: Central Statistics Agency (Processed by researchers)

Furthermore, a comparison of the relationship between regional spending and the Human Development Index (HDI) in Figure 3 shows that increases in public spending in many provinces are not always accompanied by a proportional increase in the HDI. This phenomenon indicates potential inefficiencies in fiscal resource management, where increased fiscal inputs have not yet resulted in optimal human development outputs (Purwanto and Utami, 2023). Provinces with high spending levels show highly variable HDI achievements. DKI Jakarta, for example, has large regional spending and a high HDI, while Papua shows relatively high total spending but a low HDI. This pattern indicates that large regional budgets do not automatically guarantee an improvement in the quality of life of the community. To examine this phenomenon in more detail, Table 1 presents several provinces that experienced increases in regional spending but actually recorded a decline in the HDI during the observation period.

Table 1. Provinces with Increased Regional Spending and Decreased Human Development Index

Province	IPM	IPM	Changes in the Human Development Index	Shopping (Billions of Rupiah)	Shopping (Billion Rp)
Nusa Tenggara Timur	65.23	65.19	-0.04	2.55	2.78
Riau	73.00	72.21	-0.29	3.06	3.25
Sumatera Selatan	70.02	70.01	-0.01	4.02	4.20

Source: Central Statistics Agency and Directorate General of Fiscal Balance (Processed by researchers)

Table 1 shows that several provinces experienced increases in regional spending, but not accompanied by increases in the Human Development Index (HDI), and even tended to decline. East Nusa Tenggara, for example, experienced an increase in spending from 2.55 billion to 2.78 billion rupiah, but the HDI fell from 65.23 to 65.19. A similar situation occurred in Riau, where an increase in spending from 3.06 billion to 3.25 billion rupiah was accompanied by a

decrease in the HDI from 73.00 to 72.21. This phenomenon reinforces indications of budget inefficiency, where increased spending has not been translated into optimal improvements in the quality of human development (Purwanto & Utami, 2023; Hibatulmedina & Rambe, 2022). Human development issues in Indonesia are not only related to the size of the allocated budget, but also to the effectiveness and efficiency of its use.

Therefore, efficiency needs to be examined in this study to answer the question of whether regional spending has produced maximum human development outputs at a given input level, while also identifying room for improvement and best practices across provinces. From a policy perspective, this research is also relevant because increasing the efficiency of regional spending is seen as key to improving the quality of public services. The World Bank has specifically approved a program to support the Indonesian government in improving the equity, efficiency, and accountability of regional government spending financed by intergovernmental transfers (World Bank, 2023). Furthermore, measuring efficiency is important because public spending in developing countries typically reaches 20–30% of GDP, so even small efficiency improvements can have a significant impact on achieving public service objectives (Herrera & Ouedraogo, 2018).

Several previous studies have analyzed the relationship between regional spending and human development. However, most of these studies have not examined fiscal efficiency across provinces longitudinally and comprehensively. Purwanto and Utami (2023) focused only on disadvantaged regions (2017–2019), Kurniawan and Murtala (2021) analyzed 34 provinces (2014–2018), thus failing to capture post-pandemic dynamics. Meanwhile, Hibatulmedina and Rambe (2022) limited their study to districts/cities in Sumatra and covered a single year. Other studies, such as those by Puspitasari (2021), Abidin (2022), and Ikhwan (2021), have also not been conducted longitudinally and have not comprehensively examined the determinants of interregional efficiency over the long term.

Therefore, this study aims to fill this gap by analyzing the efficiency of regional spending on human development longitudinally for the period 2015–2024, while also identifying factors influencing variations in efficiency between provinces. Specifically, the objectives of this study are: 1) To measure the level of efficiency of regional government spending in improving the Human Development Index (HDI) in 34 provinces in Indonesia during the period 2015–2024. 2) To analyze the factors influencing variations in efficiency between provinces in Indonesia.

Methods

Research Type

This study uses a quantitative approach with a two-stage analysis method, combining efficiency analysis using Data Envelopment Analysis (DEA) in the first stage and Tobit regression in the second stage. The quantitative approach was chosen because it is based on a positivistic paradigm, which views social phenomena as objectively measurable through numerical data and statistical analysis (Sugiyono, 2023). In line with Julhadi et al. (2022), quantitative research aims to verify theories and test relationships between variables through systematic analytical procedures based on numerical data. Using the two-stage DEA method, the first stage is used to measure relative efficiency across provinces, while the second stage is used to identify economic, social, and demographic factors that influence variations in efficiency.

The research subjects were 34 provinces (DMU) during 2015–2024. DMU homogeneity is met because all provinces operate within the framework of the Regional Revenue and Expenditure Budget (APBD) and comparable expenditure functions, allowing for relative comparison of inputs and outputs. The data used in this study is secondary data obtained from official government institutions such as the Central Statistics Agency (BPS), the Directorate General

of Financial Balance (DJPK), and official regional government publications. The data used is panel data, a combination of time series data (2015–2024) and cross-provincial data (34 provinces). This panel data is used both in the DEA efficiency measurement stage and in the Tobit regression analysis.

Analysis Method

Data Envelopment Analysis (DEA)

To measure the efficiency of local government spending, this study employed the non-parametric Data Envelopment Analysis (DEA) method. DEA is widely used to measure the technical efficiency of various public sector entities, including government agencies and regional development units (Cichowicz et al., 2021).

In this regard, DEA has several advantages. First, DEA can be used to determine the relative efficiency levels between Decision-Making Units (DMUs), and can utilize multiple outputs and inputs with different units. Second, the DEA method can also provide information on Decision-Making Units (DMUs) that are not using inputs efficiently, leading to inefficiencies in both input and output variables. Finally, this method can provide information on how much input and output should be adjusted to achieve maximum relative efficiency. DEA efficiency values range from 0–1 (or 0–100%). A DMU with a score of 1 is categorized as efficient, while a score below 1 indicates inefficiency.

This study employed input-oriented DEA with the assumption of Variable Returns to Scale (VRS). The input-oriented approach was chosen because the focus of this research is to assess the efficiency of local government spending (input) in producing human development outcomes (output). Local governments are assumed to have more control over inputs (spending allocations) than outputs (HDI values and their components).

The VRS assumption was used because the 34 provinces included in this study accommodate differences in provincial scale and characteristics (population, area, economic capacity), making it unrealistic to assume all provinces operate at the same optimal scale. VRS allows for a disproportionate input-output relationship, which is then also examined using Return to Scale (RTS).

The variables used in this study are Education Expenditure (BP), Health Expenditure (BK), and Economic Expenditure (BE), while the output variables are Life Expectancy (AHH), Average Years of Schooling (RLS), Expected Years of Schooling (HLS), and Per Capita Expenditure (PK). The selection of input-output variables aligns with Abidin (2022), Puspitasari (2021), and several similar studies assessing the efficiency of government spending on human development. Input variable data was obtained from the Directorate General of Taxes and Taxation (DJPK), while output variable data was obtained from the Statistics Indonesia (BPS). DEA processing was performed using MaxDEA 12.2 software.

Tobit Regression

The second stage of the study used Tobit regression analysis to identify factors influencing variations in DEA efficiency scores between provinces. The Tobit model was introduced by Tobin (1958) as a solution when the dependent variable is censored, for example, defined only within a certain range. Gujarati (2003) explained that in such conditions, the use of OLS can produce biased and inconsistent estimates, making the maximum likelihood approach in the Tobit model more appropriate.

In this study, the DEA efficiency score (EFF) ranges from 0 to 1 and is therefore treated as a censored dependent variable. Because the EFF falls within this range, the Tobit model was

used with a lower bound of 0 and an upper bound of 1 to ensure that the estimates are consistent with the data characteristics. The Tobit method is widely used as the second stage in two-stage DEA studies to analyze efficiency determinants (Madarević et al., 2021; Gao et al., 2024). Several variables have been selected as independent variables, namely Gross Regional Domestic Product per Capita (GRDP per Capita), Poverty Rate, and Population Density (DP). The data used in running the Tobit regression is panel data, with the Tobit model as follows:

$$EFF_{it} = \beta_0 + \beta_1 \ln GRDP_t + \beta_2 TK_{it} + \beta_3 KP_{it} + \varepsilon_{ct}$$

where, EFF_{it} : DEA efficiency score of province i in year t (0–1); $\ln PDRB_{it}$: natural logarithm of GRDP per capita of province i in year t , which reflects the region's economic and fiscal capacity; TK_{it} : poverty rate of province i in year t , which reflects the limited ability of households to invest in education and health; KP_{it} : population density of province i in year t , which describes the spatial characteristics of the region that influence the scale and cost of public service provision; $\beta_0, \beta_1, \beta_2, \beta_3$: estimated parameters; and ε_{it} : error term.

The data used in the Tobit regression is panel data from 34 provinces for the period 2015–2024, with the DEA efficiency score as the dependent variable and the three explanatory variables as independent. The estimation results are used to test the hypothesis regarding the influence of GRDP per capita, poverty rate, and population density on the efficiency of provincial government spending in Indonesia.

Table 2. Tobit Variable Specifications

Tobit Variable	Operational Definition	Unit	Reference	Data Source
Efficiency (EFF/Y)	Efficiency score measured using input-oriented DEA with Variable Returns to Scale (VRS), employing economic, education, and health expenditure functions as inputs and human development indicators as outputs	0–1	Kaya Samut & Cafri (2016); Tasnim & Afzal (2018)	DEA Estimation Results
GRDP per Capita (X1)	Natural logarithm of GRDP per capita at constant prices (million rupiah per capita)	Log	Gao, Cao & Gu (2024); Rambe, Alisjahbana & Wibowo (2022)	Statistics Indonesia (Badan Pusat Statistik)
Poverty Rate (X2)	Percentage of poor population relative to total population by province	Percent (%)	Idris et al. (2023); Wardiah (2021); Fadilah (2023); Rahmawati et al. (2023)	Statistics Indonesia (Badan Pusat Statistik)
Population Density (X3)	Total population divided by land area (persons per km ²)	Persons/km ²	Gao, Cao & Gu (2024); Rambe, Alisjahbana & Wibowo (2022)	Statistics Indonesia (Badan Pusat Statistik)

Results and Discussion

Efficiency Levels of Provinces in Indonesia

The research results are presented as efficiency scores ranging from 0 to 1. A score of 1 (100%) reflects a province's ability to optimally manage input and output variables. Conversely, the further the efficiency score is from 1, the more it indicates that the province is inefficient or unable to optimally convert spending on economic, education, and health functions into human development outcomes. The efficiency scores of provinces in Indonesia after DEA data processing can be seen in Table 3.

Table 3. Efficiency Levels of Provinces in Indonesia

DMU	VRS										
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	RTS
Aceh	0.14	0.19	0.15	0.16	0.14	0.20	0.20	0.18	0.21	0.23	DRS
Sumatera Utara	0.37	0.32	0.29	0.27	0.31	0.32	0.22	0.22	0.30	0.30	DRS
Sumatera Barat	0.37	0.35	0.25	0.23	0.25	0.32	0.24	0.27	0.26	0.30	DRS
Riau	0.24	0.22	0.25	0.29	0.29	0.34	0.36	0.33	0.21	0.21	DRS
Jambi	0.41	0.40	0.42	0.39	0.35	0.44	0.27	0.28	0.33	0.32	DRS
Sumatera Selatan	0.34	0.45	0.32	0.30	0.33	0.35	0.19	0.17	0.17	0.21	DRS
Bengkulu	0.49	0.56	0.52	0.48	0.53	0.68	0.54	0.65	0.46	0.52	DRS
Lampung	0.32	0.31	0.27	0.29	0.31	0.31	0.26	0.29	0.20	0.19	DRS
Kep. Bangka	1.00	1.00	0.76	0.83	0.77	0.75	0.83	1.00	0.82	0.83	DRS
Kep. Riau	1.00	1.00	0.91	1.00	0.94	1.00	0.85	1.00	1.00	1.00	DRS
DKI Jakarta	1.00	0.98	1.00	0.95	1.00	1.00	0.87	0.90	1.00	1.00	DRS
Jawa Barat	0.14	0.14	0.14	0.14	0.13	0.13	0.06	0.08	0.08	0.08	DRS
Jawa Tengah	0.21	0.16	0.14	0.39	0.20	0.28	0.10	0.15	0.12	0.17	DRS
DI Yogyakarta	1.00	0.78	0.85	1.00	1.00	1.00	0.94	1.00	1.00	1.00	DRS
Jawa Timur	0.07	0.06	0.05	0.05	0.06	0.08	0.07	0.06	0.06	0.06	DRS
Banten	0.31	0.35	0.30	0.34	0.24	0.28	0.15	0.16	0.17	0.20	DRS
Bali	0.54	0.62	0.52	0.60	0.61	1.00	0.46	1.00	0.65	0.79	DRS
NTB	0.30	0.32	0.33	0.35	0.28	0.31	0.29	0.25	0.27	0.28	DRS
NTT	0.25	0.24	0.25	0.23	0.29	0.32	0.28	0.13	0.19	0.18	DRS
Kalimantan Barat	0.32	0.31	0.24	0.27	0.27	0.30	0.38	0.21	0.18	0.19	DRS
Kalimantan Tengah	0.39	0.45	0.36	0.31	0.32	0.37	0.25	0.31	0.30	0.27	DRS
Kalimantan Selatan	0.29	0.29	0.23	0.28	0.27	0.33	0.31	0.36	0.26	0.33	DRS
Kalimantan Timur	0.49	0.61	0.49	0.59	0.61	0.84					

Source: Data processed by researchers (2025)

The DEA efficiency scores in this study are relative to the sample frontier. A low score does not automatically mean a province is performing poorly in absolute terms, but rather indicates that, with its combination of expenditure inputs, the province has not achieved a combination of human development outputs as high as those of the frontier provinces during the same period. This is especially important for large-scale provinces facing complex public services and regional heterogeneity.

The DEA results indicate that several provinces, such as the Riau Islands, Yogyakarta Special Region, the Bangka Belitung Islands, Maluku, and North Kalimantan, achieved the maximum score (efficiency = 1) several times during the observation period. These provinces can be considered efficiency benchmarks (best practices) because they are relatively able to convert spending on education, health, and economic functions into HDI component outcomes more effectively than other provinces in the sample. This relative efficiency is generally more easily achieved when public services can be delivered at lower unit costs and more precisely targeted, for example in relatively concentrated areas, with more adequate access to basic services, and with more direct program implementation linked to improving education, health, and living standards. This condition allows additional spending to be more quickly reflected in outputs such as increased RLS/HLS, improved health, and strengthened living standards.

In contrast, Central Java and East Java demonstrated the lowest efficiency scores, with average values well below 0.20 throughout the study period, indicating that additional spending in these two provinces has not been fully translated into improvements in human development indicators. This is because these provinces face challenges related to the scale and complexity of services in large-population provinces, the need for equitable distribution across regions, and the accumulative and lagged nature of the HDI indicator. Therefore, additional spending in a single period does not necessarily significantly improve output indicators. Thus, while population concentration can support efficiency through economies of scale, in large provinces, these benefits can be offset by the burden of equitable distribution, regional heterogeneity, and the slow response of the HDI indicator. The finding regarding East Java's low efficiency is consistent with Ikhwan (2021), who also identified this province as one of the regions with the weakest efficiency performance.

The average efficiency level of provincial government spending in Indonesia tends to fluctuate. The national average increased from 0.46 in 2015 to 0.49 in 2016, then declined to a range of 0.43–0.45 in 2017–2019. In 2020, as COVID-19 began to spread, the average efficiency actually increased slightly to 0.50, possibly reflecting a budget refocusing on health and social protection functions. However, in 2021, efficiency dropped sharply to 0.41 due to prolonged pressure on regional fiscal capacity, before recovering in 2022–2024, with an average of around 0.46–0.48. This fluctuating pattern aligns with the findings of Purwanto and Utami (2023) who demonstrated the dynamics of spending efficiency across regions and over time in Indonesia.

In addition to the efficiency score, Table 3 also presents information on the Return to Scale (RTS), used as an indicator to illustrate a province's ability to generate human development outputs from additional regional spending inputs. In the relationship between production factors (inputs) and output levels, the RTS describes the response of output changes to proportional changes in all inputs. Most provinces in Indonesia are experiencing a Decreasing Returns to Scale (DRS) condition, meaning that increasing all spending components by the same proportion only results in a smaller increase in output. This DRS dominance pattern is consistent with the trend found in the study by Purwanto and Utami (2023), where spending increases in many underdeveloped regions were not always accompanied by comparable increases in efficiency. This confirms that budget increases alone are insufficient; without improving the quality of planning and spending management, increases in fiscal input will not

result in proportional increases in human development. The policy implication of this finding is the need to shift focus from simply increasing the budget to improving the quality of spending, including sharpening beneficiary targets, increasing program effectiveness, and improving governance to make spending more productive towards the HDI indicator.

Comparison of Average Provincial Government Spending Efficiency in Indonesia

The development of average provincial government spending efficiency during the 2015–2024 period is shown in Figure 6. Overall, the national average is in the range of 0.41–0.50 and tends to fluctuate from year to year. At the beginning of the period, efficiency increased from around 0.46 in 2015 to 0.49 in 2016, then weakened in 2017–2019, with the average decreasing to around 0.43–0.45.

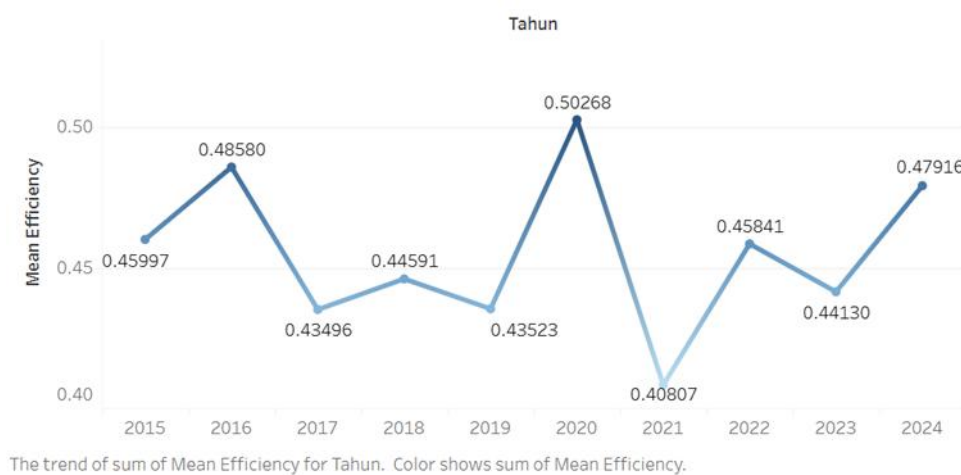


Figure 4. Average Trend in Provincial Government Spending Efficiency in Indonesia, 2015–2024

Source: Data processed by researchers (2025)

In 2020, when the Covid-19 pandemic began to spread in Indonesia, the average efficiency actually increased to around 0.50. This increase may reflect a refocusing of the budget on health and social protection sectors, which are more directly linked to human development indicators. However, in 2021, efficiency dropped drastically to around 0.41, indicating prolonged pressure on fiscal capacity and the quality of regional expenditure management. After that, efficiency gradually improved in 2022–2024, with the average rebounding to around 0.46–0.48, although it has not yet reached full efficiency.

Comparison of Expenditure Efficiency between Java–Bali and Outside Java–Bali Provinces

A comparison of average efficiency between Java–Bali and Outside Java–Bali provinces is presented in Figure 7. This comparison is based on the unequal regional characteristics of Indonesia, particularly between Java and the regions outside Java. The results of the 2020 Population Census show that Indonesia's population remains concentrated on the island of Java (approximately 56.10% or 151.6 million people), while regions outside Java and Bali are relatively more dispersed, with highly variable density and access to services (BPS, 2021). This comparison also aligns with regional inequality analyses that use Java and Bali as a benchmark, for example when measuring the process of regional income convergence "catch-up with Java and Bali" (World Bank, 2024). In general, both groups of provinces exhibit a similar trend, but with different levels of efficiency. In most observation years, provinces outside Java and Bali tended to have slightly higher average efficiency than those in Java and Bali. This indicates that although Java and Bali generally have greater fiscal capacity, the conversion of spending

into human development outcomes in some provinces outside Java and Bali is relatively more efficient.

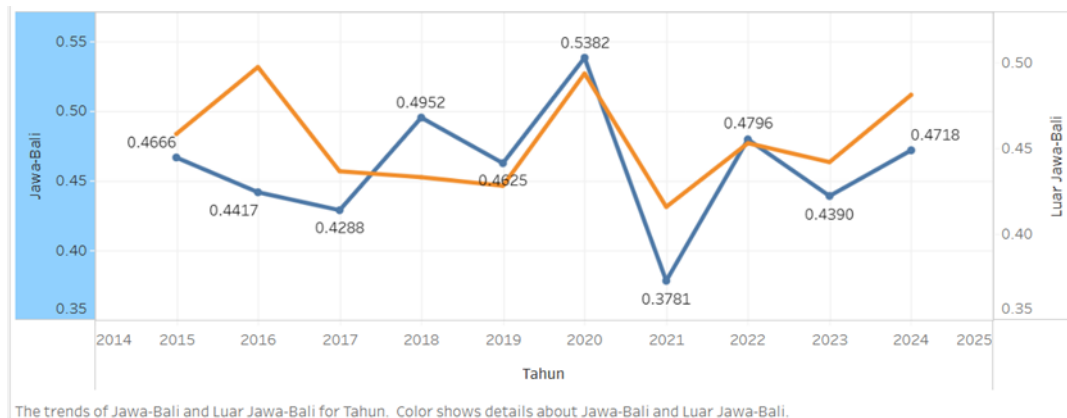


Figure 5. Comparison of Average Trends in Government Spending Efficiency in Java–Bali and Outside Java–Bali Provinces, 2015–2024

Source: Data processed by researchers (2025)

2020 marked a peak for both groups, with average efficiency in Java–Bali and outside Java–Bali both increasing sharply. Conversely, in 2021, efficiency declined sharply, particularly in the Java–Bali region, before rebounding in 2022–2024. This pattern suggests that the pandemic shock impacted fiscal efficiency across all regions, but efficiency recovery appeared to be faster outside Java–Bali. This finding underscores the disparity in efficiency performance between regions and the importance of improving the quality of planning and expenditure management, particularly in the Java–Bali provinces.

Table 4. Potential Improvement Analysis

Province	Input Variables			Output Variable			
	Economic Shopping	Education Shopping	Health Shopping	Life Expectancy	Average Length of Schooling	Expected Years of Schooling	Income per Capita
Aceh	0.00	0.00	-149.40	0.23	0.00	0.00	1856.91
Sumatera Utara	-74.88	0.00	-79.67	0.87	0.14	0.75	0.00
Sumatera Barat	-54.45	0.00	0.00	0.14	0.59	0.77	0.00
Riau	-14.61	-91.45	-0.91	0.89	0.15	0.95	11.91
Jambi	0.00	0.00	-75.64	0.21	0.02	0.00	450.33
Sumatera Selatan	0.00	-39.37	-3.68	0.02	0.02	0.00	78.31
Bengkulu	0.00	0.00	-234.20	0.16	0.00	0.12	0.00
Lampung	-18.31	-13.57	0.00	0.57	0.70	0.16	55.03
Kep. Bangka	-3.07	0.00	0.00	0.00	0.20	0.53	7.71
Kep. Riau	0.00	-303.51	0.00	0.00	0.64	2.25	1580.04
DKI Jakarta	0.00	-147.62	-194.73	0.00	1.67	2.28	2133.29
Jawa Barat	0.00	0.00	-49.69	0.00	0.82	0.02	0.00
Jawa Tengah	-5.97	0.00	-4.84	0.00	1.24	0.87	1116.55
DI Yogyakarta	-124.95	0.00	-72.19	1.48	0.11	0.11	0.00
Jawa Timur	-88.32	0.00	-5.05	0.02	0.07	0.58	0.00
Banten	-533.29	0.00	-612.16	0.00	0.00	1.35	1779.20
Bali	-34.35	0.00	-25.58	0.00	0.00	0.42	929.26

NTB	0.00	0.00	-0.30	0.13	0.00	0.07	14.22
NTT	-13.77	0.00	-0.64	0.00	0.55	0.64	598.99
Kalimantan Barat	-5.69	0.00	0.00	1.66	0.00	0.00	1269.89
Kalimantan Tengah	-29.18	0.00	-2.69	1.17	0.00	0.00	2788.28
Kalimantan Selatan	0.00	0.00	-100.96	3.08	1.28	0.00	243.61
Kalimantan Timur	-5.45	-203.06	0.00	0.95	0.88	0.03	2038.85
Kalimantan Utara	-49.53	0.00	-19.95	2.10	1.49	2.06	2424.15
Sulawesi Utara	-304.41	-109.29	0.00	1.40	0.86	0.3	

Source: Data processed by researchers (2025)

In addition to generating efficiency scores, the DEA method can also be used to calculate potential improvement, or the level of improvement required for each DMU to achieve maximum efficiency. This analysis reveals which input variables can still be saved and which output variables need to be increased. Potential improvement is measured using the most recent observation year and calculated separately from previous years to reflect the current state that must be achieved. The results of the potential improvement measurement are presented in Table 4. Negative values for the input variables indicate the magnitude of potential spending reductions that can still be achieved without compromising human development outcomes, while positive values for the output variables indicate the magnitude of indicator improvements that need to be achieved for the province to reach a point of efficiency. The greater the absolute value of the input, the greater the untapped efficiency room in expenditure, while the greater the value of the output, the greater the target for improving human development performance that must be pursued.

Table 4 shows that several provinces still have significant room for spending savings. For example, Banten and North Sulawesi have very high potential reductions in accumulated spending on the economy, education, and health, indicating that spending in these three functions is not yet fully productive in driving improvements in the HDI. These results are also supported by data processing from the Directorate General of Fiscal Balance, regarding the APBD target (budget/ceiling) and realization in the last observation year (2024). The results show a very large deviation in the budget and realization in two provinces, namely Banten with a budget of 43,994.62 and a realization of 1,410.47 (an absorption rate of around 3.21%), and North Sulawesi with a budget of 17,577.41 and a realization of 505.81 (an absorption rate of around 2.88%). This extreme deviation indicates overbudgeting, namely the setting of a relatively high spending ceiling but not followed by the ability to implement programs/activities optimally, so that planned spending is not fully distributed. This condition aligns with the DEA results in Table 4, which indicate that both provinces still have significant room for input spending reductions (accumulated potential reductions for Banten amounting to -1,145.45 and for North Sulawesi -413.70). This suggests that, with the same human development output, spending can be reduced if budget planning and implementation are more selective and effective. Thus, the high potential for improvement not only reflects efficiency opportunities from the DEA frontier but is also consistent with evidence of low absorption, which reinforces the suspicion that spending on certain functions is neither fully productive nor realistic from a budgetary perspective.

The potential improvement results indicate that room for efficiency improvements stems not only from adjustments in spending levels but also from improvements in the ability of spending

to generate human development outputs. In some provinces, there is potential for savings in spending on economic, education, and health functions without reducing output achievement to the same level, while in others, improvements are more needed in improving education indicators and living standards. These findings demonstrate the need for improved performance-based budget planning, sharpening program priorities, and strengthening implementation so that DEA target recommendations can be translated into tangible fiscal efficiencies.

DEA Robustness Test Based on Scale Assumptions (CRS-IO)

As a robustness test against scale assumptions, this study estimates the input-oriented CRS DEA model and compares it with the main input-oriented VRS DEA model. The CRS model assumes that an increase in input will be followed by a proportional increase in output, making it more stringent than the VRS.

Table 5. Average DEA CRS Input-Oriented Efficiency Score of Provincial Governments, 2015–2024

Year	Mean CRS-IO Efficiency Score
2015	0.30
2016	0.35
2017	0.30
2018	0.28
2019	0.26
2020	0.33
2021	0.22
2022	0.24
2023	0.19
2024	0.21

Source: Data processed by researchers (2025)

Note: The CRS efficiency score is an average of the 34 provinces. The CRS model assumes constant returns to scale and therefore does not produce a return to scale (IRS/DRS) classification.

Table 5 presents the input-oriented CRS efficiency scores of Indonesian provincial governments for the period 2015–2024. In general, the average CRS efficiency score is lower than the VRS score, indicating that some inefficiencies stem not only from technical spending management but also from operational scale factors. The average CRS score shows a downward trend in the post-pandemic period, particularly in 2021–2024. This indicates that fiscal pressures and changes in spending priorities have the potential to exacerbate scale inefficiencies in the provision of regional public services. Nevertheless, the efficiency pattern across provinces remains relatively consistent with the VRS model, so the main conclusion of this study regarding variations in provincial government spending efficiency is not sensitive to changes in scale assumptions.

Tobit Regression Analysis

The Tobit model was used to analyze factors influencing the level of efficiency of local government spending on human development in Indonesia. This analysis represents the second stage of the Two-Stage Approach. Estimations were performed using Stata 16 to analyze the Tobit model with a lower bound of 0 and an upper bound of 1, corresponding to the DEA

efficiency score range. The results were used to summarize the factors influencing efficiency. The following are the findings from the Tobit regression analysis:

Table 6. Tobit Regression Results

Variables	Coefficient	Prob
GRDP	0.1073550	0.002
Poverty Rate	-0.0051623	0.049
Population Density	0.0000283	0.000

Source: Data processed by researchers (2025)

Based on the results in Table 6, it can be seen that the three explanatory variables exert different effects, but all are significant at the 5 percent confidence level. First, the LnGRDP variable has a coefficient of 0.107355 with a probability value of 0.002, indicating a positive and significant effect on spending efficiency. This means that an increase in GRDP per capita tends to be followed by an increase in efficiency scores. Economically, provinces with higher fiscal capacity and economic activity have greater room to adequately finance education, health, and economic services while managing them more professionally. This finding is consistent with the fiscal capacity theory (Oates, 1993) and aligns with the results of Kurian & Muzumdar (2017) and Purwanto & Utami (2023), which show that GRDP per capita is positively related to government spending efficiency and human development achievements.

Second, the Poverty Level variable has a coefficient of -0.0051623 with a probability value of 0.049, indicating a negative and significant effect on efficiency. This indicates that the higher the poverty rate in a province, the lower the efficiency of government spending in promoting human development. Conceptually, a region's poverty limits its ability to invest in education, nutrition, and health, thus reducing the human development output generated from fiscal input. This finding aligns with research by Idris, Mu'jizat, and Husain (2024), which showed that poverty had a significant negative effect on the Human Development Index (HDI) in Gorontalo Province. Research by Rahmawati et al. (2023) in Central Sulawesi also confirmed that high poverty and nutritional vulnerability are key obstacles to improving the HDI.

Third, the Population Density variable has a coefficient of 0.0000283 with a probability value of 0.000, indicating a positive and significant effect on spending efficiency. These results indicate that in Indonesian provinces, increasing population density tends to increase efficiency. Theoretically, this result reflects the dominance of the scale effect over the congestion effect: at the observed density level, government spending can be utilized by a larger population, thus reducing per capita costs and increasing efficiency. This finding aligns with de Borger & Kerstens (1996), who demonstrated that population density can reduce the average cost of public services through economies of scale. This finding is supported by Purwanto & Utami (2023) and Ikhwan (2021), who found that population variables and regional characteristics play a significant role in explaining variations in public spending efficiency across regions.

In general, these Tobit results indicate that provincial government spending efficiency in Indonesia is significantly influenced by three main structural factors: regional economic capacity, poverty levels, and the spatial structure of the population. Provinces with high per capita GRDP, low poverty, and population densities that leverage economies of scale tend to be more efficient in converting public spending into improvements in human development. Conversely, provinces with limited fiscal capacity, high poverty, and dispersed settlement patterns face greater challenges in achieving efficiency. This research finding confirms that efficiency improvements depend not only on spending policies but also on the socio-economic

context of the region. Therefore, strategies for increasing efficiency need to be differentiated across provinces, for example, through strengthening fiscal capacity and program governance in high-poverty provinces, and leveraging economies of scale in more densely populated areas.

Conclusion

Indonesian provinces for the 2015–2024 period using the input-oriented VRS (Developmental Analysis and Analysis) model and Tobit regression. Government spending on economic, education, and health functions is evaluated against human development outcomes. The analysis shows that average efficiency fluctuates and generally has not reached full efficiency. Several provinces, such as the Riau Islands, Yogyakarta Special Region, the Bangka Belitung Islands, Maluku, and North Kalimantan, have achieved a score of 1 several times and can be used as benchmarks, while Central Java and East Java consistently have low efficiency scores. The analysis of potential improvements shows that many provinces still have significant room for savings in economic, education, and health functions without compromising human development outcomes. They also need to improve education indicators and per capita spending to reach the efficiency frontier. These findings indicate that the primary issue with efficiency lies not solely in budget size, but rather in the ability of local governments to manage and convert fiscal input into tangible improvements in human development. The Tobit regression results show that per capita GRDP and population density have a positive and significant effect on efficiency, while poverty rates have a negative and significant effect. This means that provinces with stronger economic capacity and supportive spatial structures tend to be more efficient in utilizing their fiscal space, while high poverty levels weaken the effectiveness of public spending. Therefore, strengthening fiscal capacity, reducing poverty, and structuring public services that take population density into account are key to improving the efficiency of provincial government spending and accelerating human development in Indonesia.

Suggestion

Based on the research findings, local governments are advised to prioritize quality spending through performance-based budgeting, program refinement, and strengthened implementation to ensure spending on education, health, and the economy more effectively generates human development outcomes. Local governments can also utilize consistently efficient provinces as benchmarks for replicating better spending management practices. Furthermore, because poverty has been shown to reduce efficiency, strengthening poverty reduction programs needs to be integrated as a supporting strategy to enhance the impact of human development spending. Finally, spending planning should be tailored to regional characteristics, including population density and service scale, to ensure resource allocation is more efficient and aligned with regional needs.

Research Implications

The results of this study confirm that improving human development is not sufficient simply through budget increases; instead, a focus on the quality of local government spending is needed. The dominant decreasing returns to scale indicates that additional spending in many provinces does not automatically increase human development outputs commensurately. Therefore, spending management needs to be directed toward targeting accuracy, program effectiveness, and outcome achievement. The findings on efficiency determinants also imply that efficiency improvements do not stand alone, as they are influenced by regional economic capacity (per capita GRDP) and population density, which tend to increase efficiency while poverty decreases it. Thus, policy strategies need to consider differences in socio-economic

and spatial conditions between provinces to ensure more realistic and contextual efficiency improvements.

The results of this study are expected to provide empirical contributions to the literature on public sector fiscal efficiency, particularly regarding the relationship between government spending and human development at the regional level. Furthermore, the findings are expected to provide input for policymakers, both at the central and regional levels, in optimizing regional financial management to significantly impact the quality of life of the community and promote equitable human development across provinces in Indonesia.

Research Limitations

This study has several limitations. First, the study uses 34 provinces because the expansion of provinces (to 38 provinces) only occurred in 2022 and adequate time series data is not yet available. Second, the study uses provincial-level data, thus not capturing variations in spending performance at the district/city level. Third, the Tobit model used only includes three determining variables (GRDP per capita, poverty rate, and population density), thus failing to account for other factors such as governance quality, fiscal transfer design, political variables, or macroeconomic shocks beyond COVID-19.

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