

Efficiency and Effectiveness of Government Expenditure on Health in The Districts of East Nusa Tenggara Province

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Article Info	ABSTRACT
Article history: Received 2026-03-30 Revised 2026-04-17 Accepted 2026-05-17 Keywords: Efficiency Effectiveness Government Expenditure Data Envelopment Analysis Panel Data Regression	Local governments have attempted to allocate health budgets in accordance with constitutional mandates; however, the life expectancy remains relatively low. This study examines the efficiency and effectiveness of public health spending in 22 districts/cities in East Nusa Tenggara Province (NTT) during 2017–2024. Efficiency was assessed using Data Envelopment Analysis (DEA) with Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) assumptions. Effectiveness was analyzed through panel data regression from the Central Statistics Agency (BPS) for 2017–2024, lagged by 1 year, and using a fixed effects model. The DEA findings indicate that most regions have not achieved optimal technical efficiency, largely due to geographic constraints and scale inefficiencies. Meanwhile, the regression results indicate that government health spending does not significantly affect life expectancy. In contrast, GDP per capita and access to clean water exhibit significant positive effects. However, household health spending exhibits a significant negative relationship, indicating a significant financial burden for individuals. These findings highlight the importance of reallocating health budgets, prioritizing capacity building for medical personnel, and strengthening financial protection mechanisms through expanding health insurance coverage. <i>This is an open-access article under the CC BY-SA license.</i> 
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1. INTRODUCTION

The provision of basic public services, particularly in the health sector, plays a crucial role in shaping human capital and long-term economic development. In Indonesia, the implementation of fiscal decentralization through Law Number 23 of 2014 has granted local governments broader authority to manage regional finances and allocate resources according to local priorities. In this context, the effectiveness and efficiency of government expenditure have become key indicators in evaluating the success of regional development

policies [1]. Furthermore, the enactment of Law Number 17 of 2023 emphasizes a shift from minimum budget allocation toward needs-based and program-oriented health financing, highlighting the importance of optimal resource utilization in improving public health outcomes [2], [3].

Despite these policy frameworks, empirical challenges remain significant, particularly in East Nusa Tenggara (NTT) Province. As an archipelagic region with complex geographical conditions, NTT faces structural constraints such as limited accessibility, uneven distribution of healthcare personnel, and inadequate health infrastructure [4]. These limitations contribute to relatively low health outcomes, as reflected in life expectancy, which remains below the national average. In 2024, life expectancy in NTT was recorded at 67.99 years, compared to the national average of 72.39 years. Moreover, the Human Development Index (HDI) of NTT ranks among the lowest in Indonesia, indicating persistent disparities in human development [5].

A critical issue arises from the inconsistency between government health expenditure and health outcomes across districts and cities in NTT. Although local governments are mandated to allocate at least 10% of their regional budgets to the health sector, the variation in life expectancy across regions suggests that higher spending does not necessarily translate into better health performance. This phenomenon raises concerns regarding the efficiency and effectiveness of public health expenditure, particularly in regions with limited fiscal capacity and geographical challenges.

To address these issues, this study provides a comprehensive analytical framework that integrates efficiency and effectiveness assessments. Specifically, this research employs Data Envelopment Analysis (DEA) to measure technical efficiency and panel data regression to evaluate the effectiveness of health expenditure. By combining these approaches, this study aims to offer a more holistic understanding of how government spending translates into health outcomes and to provide policy-relevant insights for improving budget allocation strategies.

From a theoretical perspective, efficiency refers to the ability to maximize outputs given a set of inputs or minimize inputs required to achieve a certain level of output [6], while effectiveness refers to the extent to which intended objectives are achieved [7]. In the public sector context, both concepts are interrelated and essential for evaluating government performance. Therefore, assessing both efficiency and effectiveness simultaneously is crucial to understanding whether public resources are utilized optimally and whether they produce meaningful impacts on societal welfare.

Previous studies have explored the relationship between government expenditure and health outcomes with mixed findings. For instance, research by Solihin et al. [8] indicates that large budget allocations do not necessarily guarantee efficiency if resource management is suboptimal. Similarly, Fadli [9] finds that government health spending does not significantly affect health indices, suggesting limitations in expenditure effectiveness. On the other hand, studies in developing countries highlight that inefficiencies often arise due to governance weaknesses, institutional constraints, and misallocation of resources [10], [11].

However, several research gaps remain. First, most previous studies tend to focus solely on either efficiency or effectiveness, without integrating both dimensions into a single analytical framework. Second, empirical studies focusing on regions with extreme geographical characteristics, such as NTT, are still limited. Third, existing research often overlooks the role of non-governmental determinants, such as household health expenditure and access to clean water, which are critical factors influencing health outcomes, especially in underdeveloped regions.

This study contributes to the literature by addressing these gaps through several novelties. First, it integrates DEA and panel data regression to analyze efficiency and effectiveness simultaneously. Second, it focuses on 22 districts/cities in East Nusa Tenggara Province, a region with relatively low human development and unique geographical challenges. Third, it incorporates additional variables, including household health expenditure and access to clean water, to provide a more comprehensive analysis of health determinants.

Furthermore, this study develops several hypotheses regarding the determinants of health outcomes. Government health expenditure is expected to positively influence life expectancy, as it reflects public investment in healthcare services. Household health expenditure is theoretically expected to have a positive effect, as it indicates the ability of individuals to access healthcare services. However, in low-income regions, such expenditures may represent catastrophic out-of-pocket payments, which can reduce overall welfare and negatively impact health outcomes [12]. Therefore, the direction of this relationship requires empirical verification. Additionally, GRDP per capita and access to clean water are expected to positively influence health outcomes, as they represent economic capacity and environmental health conditions, respectively.

Based on the above discussion, the main objective of this study is to analyze the efficiency and effectiveness of government health expenditure in districts and cities in East Nusa Tenggara Province during the period 2017–2024. Specifically, this study seeks to answer the following research questions: (1) What is the level of efficiency of government health expenditure? and (2) How do government spending, household expenditure, GRDP per capita, and access to clean water affect life expectancy as a proxy for health outcomes?

This study is expected to contribute both theoretically and practically. From a theoretical perspective, it enriches the public economics literature by integrating efficiency and effectiveness analyses in the health sector. From a practical perspective, the findings provide insights for policymakers in designing more efficient and effective health expenditure policies, particularly in regions with limited fiscal capacity and complex geographical conditions.

2. METHOD

This study employs a quantitative approach to analyze both the technical efficiency and effectiveness of government health expenditure in 22 districts/cities in East Nusa Tenggara Province over the period 2017–2024. To obtain a comprehensive understanding, this study integrates two complementary analytical methods, namely Data Envelopment Analysis (DEA) to measure technical efficiency and panel data regression to evaluate the

effectiveness of government spending on health outcomes. This combined approach has been widely used in public sector performance analysis to capture both resource utilization and outcome achievement simultaneously [13].

The efficiency analysis is conducted using DEA, where the Decision Making Unit (DMU) is defined as each district/city-year observation. Thus, the analysis consists of 176 DMUs, derived from 22 districts/cities observed over eight years. This specification enables the model to capture both cross-sectional and intertemporal variations in efficiency, which is particularly relevant in regions characterized by structural disparities and dynamic fiscal conditions. DEA is a non-parametric method that evaluates the relative efficiency of decision-making units by constructing an efficient frontier, allowing comparison across units with multiple inputs and outputs [14].

The DEA model is specified as an output-oriented model, reflecting the assumption that local governments aim to maximize health service outputs given limited fiscal resources. This orientation is consistent with public sector objectives, where budget constraints are relatively fixed, and the primary goal is to improve service delivery outcomes [15]. Two model assumptions are applied, namely Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The CRS model measures overall technical efficiency, while the VRS model captures pure technical efficiency by accounting for scale effects. The comparison between these two models allows for the identification of scale inefficiencies, which are particularly relevant in geographically fragmented regions such as East Nusa Tenggara [30].

The input variable used in the DEA model is government health expenditure, measured as the ratio of health expenditure to total regional expenditure. This measure reflects the degree of fiscal prioritization toward the health sector and ensures comparability across regions with different budget sizes. The output variables consist of the ratio of doctors per 100,000 population, the ratio of hospital beds per 100,000 population, and the ratio of health facilities per 100,000 population. These indicators represent key dimensions of health service capacity, including human resources, infrastructure, and service accessibility. The use of standardized ratios is consistent with previous studies in health efficiency analysis and helps avoid bias due to population size differences [17].

To complement the efficiency analysis, this study employs panel data regression to evaluate the effectiveness of health expenditure in improving health outcomes. The dependent variable is life expectancy, measured in years, which serves as a widely accepted proxy for population health status [2]. The independent variables include government health expenditure, household health expenditure, gross regional domestic product (GRDP) per capita, and access to clean water. A one-year lag structure is applied to all independent variables to account for the delayed effects of policy interventions and socio-economic conditions on health outcomes.

From a theoretical perspective, government health expenditure is expected to have a positive effect on life expectancy, as it reflects public investment in healthcare services and infrastructure [18]. Household health expenditure is theoretically associated with improved access to healthcare services; however, in low-income regions, it may also

reflect out-of-pocket or catastrophic spending, which can reduce welfare and negatively affect health outcomes [9]. Therefore, the direction of its effect remains an empirical question. GRDP per capita is expected to positively influence life expectancy, as higher income levels improve access to nutrition, healthcare, and better living conditions [1]. Similarly, access to clean water is expected to have a positive impact, as it reduces the prevalence of waterborne diseases and improves environmental health conditions [19].

The panel regression model is specified as follows:

$$LE_{it} = \alpha_0 + \alpha_1 PPK_{it-1} + \alpha_2 PRTK_{it-1} + \alpha_3 \ln PDRB_{it-1} + \alpha_4 PABL_{it-1} + \mu_{it}$$

where LE_{it} denotes life expectancy (in years) in district i at time t , PPK represents government health expenditure, $PRTK$ denotes household health expenditure, $\ln PDRB$ is the logarithm of GRDP per capita, and $PABL$ indicates access to clean water.

To determine the appropriate model specification, a series of panel data tests are conducted, including the Chow test, Hausman test, and Lagrange Multiplier (LM) test. The results indicate that the Fixed Effects (FE) model is the most appropriate specification, suggesting the presence of unobserved heterogeneity across districts, such as differences in institutional quality, geographic conditions, and socio-economic characteristics. The use of the Fixed Effects model is consistent with previous empirical studies in regional public finance and health economics [20].

To ensure the robustness and reliability of the estimation results, several diagnostic tests are performed. Multicollinearity is assessed using the Variance Inflation Factor (VIF), while heteroskedasticity is tested using the Breusch–Pagan test. Autocorrelation is examined using the Wooldridge test, and cross-sectional dependence is tested using the Pesaran CD test. Where violations of classical assumptions are detected, robust standard errors are applied to obtain consistent parameter estimates, as commonly recommended in panel data econometrics literature [12].

The data used in this study are secondary data obtained from official sources, including the Central Bureau of Statistics (BPS), the Directorate General of Fiscal Balance (DJPK), the Ministry of Health, and the National Socio-Economic Survey (Susenas). The dataset covers all 22 districts/cities in East Nusa Tenggara Province for the period 2017–2024.

3. RESULTS AND DISCUSSION

3.1. Results

This study aims to analyze the efficiency and effectiveness of government spending in the health sector in 22 regencies/cities in East Nusa Tenggara (NTT) Province for the 2017-2024 period. The method used is Data Envelopment Analysis (DEA) with Constant Return to Scale (CRS) and Variable Return to Scale (VRS) assumptions to measure efficiency, and Panel Data Regression with a Fixed Effects (FE) model to test the effectiveness of Government Health Expenditure, Household Health Expenditure, GRDP per Capita on the Life Expectancy, and Availability of Adequate Access to Clean Water, which is Life Expectancy. The DEA analysis results indicate that most regencies/cities in NTT Province have not achieved optimal technical efficiency, with geographic barriers and

economies of scale being the main factors of inefficiency. The panel data regression results indicate that, partially, Government Health Expenditure has no significant effect on Life Expectancy, while GRDP per Capita and Availability of Adequate Access to Clean Water have a significant positive effect. On the other hand, Household Health Expenditure has a significant negative effect, indicating a high burden of catastrophic out-of-pocket costs for the community.

The research data covers 22 districts/cities in East Nusa Tenggara Province for the period 2017-2024. Summary statistics show sharp disparities between regions. Life expectancy, a proxy for health quality, averages 67.2 years, but there is a significant gap between urban areas such as Kupang City and remote areas on the mainland of Timor and Sumba. In terms of input, government health spending per capita shows an average annual increase of 5.4%, but this growth is not accompanied by a linear distribution of medical personnel, indicating challenges in resource distribution.

Efficiency Analysis: Data Envelopment Analysis (DEA)

Health Sector Efficiency with Constant Return to Scale (CRS) Assumption

Table 1. Efficiency Value in 22 Regencies/Cities in East Nusa Tenggara Province 2017-2024 with Constant Return to Scale (CRS) Assumption

Regency/City	Year								Average
	2017	2018	2019	2020	2021	2022	2023	2024	
Sumba Barat	0.777	0.589	0.692	0.494	0.762	0.848	0.869	0.554	0.698
Sumba Timur	0.315	0.410	0.261	0.268	0.315	0.459	0.465	0.482	0.372
Kupang	0.250	0.194	0.155	0.178	0.195	0.195	0.271	0.318	0.220
Timor Tengah Selatan	0.179	0.160	0.175	0.169	0.159	0.156	0.117	0.164	0.160
Timor Tengah Utara	0.254	0.461	0.318	0.356	0.405	0.329	0.342	0.411	0.360
Belu	0.342	0.405	0.406	0.328	0.479	0.47	0.401	0.721	0.444
Alor	0.275	0.205	0.221	0.204	0.179	0.234	0.225	0.211	0.219
Lembata	0.431	0.640	0.495	0.487	0.820	0.692	0.701	0.605	0.609
Flores Timur	0.281	0.249	0.194	0.209	0.210	0.210	0.178	0.153	0.211
Sikka	0.320	0.261	0.227	0.236	0.284	0.223	0.215	0.195	0.245
Ende	0.302	0.331	0.236	0.189	0.261	0.341	0.246	0.041	0.243
Ngada	0.653	1.000	0.537	0.530	0.368	0.348	0.352	0.501	0.536
Manggarai	0.211	0.190	0.163	0.177	0.224	0.193	0.194	0.283	0.204
Rote Ndao	0.455	0.416	0.455	0.373	0.516	0.485	0.464	0.464	0.454
Manggarai Barat	0.259	0.303	0.230	0.216	0.290	0.234	0.154	0.227	0.239
Sumba Tengah	0.938	1.000	0.773	0.668	0.595	0.511	0.601	0.547	0.704
Sumba Barat Daya	0.199	0.244	0.255	0.190	0.279	0.377	0.309	0.287	0.268
Nagekeo	0.348	0.492	0.273	0.327	0.249	0.380	0.373	0.324	0.346
Manggarai Timur	0.301	0.202	0.239	0.221	0.201	0.086	0.177	0.142	0.196
Sabu Raijua	0.846	0.812	0.577	0.473	0.552	0.751	0.618	0.508	0.642
Malaka	0.335	0.337	0.353	0.294	0.294	0.336	0.286	0.379	0.327
Kota Kupang	0.574	0.640	0.725	0.682	1.000	0.965	1.000	0.915	0.813

Source: Data processed by DEAP 2.1, 2025

The efficiency results under the Constant Returns to Scale (CRS) assumption show that only a very limited number of districts approach full efficiency, indicating that most districts operate below the optimal production frontier when both technical and scale efficiency are considered simultaneously. Based on the CRS scores, districts can be systematically classified into three categories:

First, consistently efficient districts under CRS are those with relatively high average efficiency scores and occasional achievement of full efficiency. These include

Kota Kupang (0.813), Sumba Tengah (0.704), Sumba Barat (0.698), Lembata (0.609), Sabu Raijua (0.642), and Ngada (0.536). Among these, Kota Kupang stands out as the most efficient district, achieving perfect efficiency (score = 1.000) in multiple years (2021 and 2023). Sumba Tengah and Ngada also recorded full efficiency in 2018, indicating strong performance under optimal scale conditions.

Second, districts showing improving efficiency under CRS include Belu (0.444), Rote Ndao (0.454), Malaka (0.327), Nagekeo (0.346), and Timor Tengah Utara (0.360). These districts demonstrate gradual improvements in efficiency scores over time, suggesting better allocation of health expenditure and improvements in health service capacity. For example, Belu shows a significant increase in 2024 (0.721), indicating recent progress in performance.

Third, persistently inefficient districts under CRS are those with consistently low efficiency scores across the observation period. These include Kupang (0.220), Timor Tengah Selatan (0.160), Alor (0.219), Flores Timur (0.211), Manggarai (0.204), Manggarai Barat (0.239), Manggarai Timur (0.196), and Sikka (0.245). The low scores in these districts suggest structural challenges, including limited healthcare infrastructure, geographic constraints, and inefficient allocation of resources. Under CRS, this inefficiency reflects both technical and scale inefficiency.

Overall, the CRS results indicate that inefficiency is widespread and that only a few districts operate near optimal scale.

Health Sector Efficiency with Variable Return to Scale (VRS) Assumption

Table 2. Health Sector Efficiency with Variable Return to Scale (VRS) Assumption

Regency/City	Year								Average
	2017	2018	2019	2020	2021	2022	2023	2024	
Sumba Barat	0.872	0.907	0.917	0.839	0.867	0.849	0.875	0.800	0.866
Sumba Timur	0.809	0.847	0.835	0.838	0.879	0.899	0.914	0.908	0.866
Kupang	0.700	0.677	0.650	0.643	0.742	0.731	0.737	0.749	0.704
Timor Tengah Selatan	0.636	0.652	0.649	0.661	0.683	0.682	0.655	0.757	0.672
Timor Tengah Utara	0.727	0.773	0.772	0.767	0.773	0.747	0.745	0.795	0.762
Belu	0.782	0.798	0.782	0.776	0.869	0.838	0.823	0.808	0.810
Alor	0.786	0.815	0.813	0.808	0.777	0.784	0.762	0.799	0.793
Lembata	0.824	0.872	0.873	0.853	0.928	0.887	0.879	0.845	0.870
Flores Timur	0.784	0.758	0.747	0.777	0.731	0.713	0.699	0.718	0.741
Sikka	0.753	0.768	0.763	0.736	0.772	0.750	0.745	0.714	0.750
Ende	0.843	0.845	0.843	0.868	0.882	0.894	0.865	0.868	0.864
Ngada	0.819	1.000	0.856	0.822	0.827	0.821	0.821	0.921	0.861
Manggarai	0.632	0.626	0.617	0.618	0.673	0.678	0.664	0.673	0.648
Rote Ndao	0.838	0.836	0.815	0.797	1.000	0.997	1.000	1.000	0.910
Manggarai Barat	0.624	0.646	0.629	0.632	0.736	0.750	0.740	0.763	0.690
Sumba Tengah	1.000	1.000	0.996	0.997	0.867	0.834	0.844	0.840	0.922
Sumba Barat Daya	0.495	0.487	0.482	0.554	0.670	0.684	0.655	0.659	0.586
Nagekeo	0.663	0.758	0.727	0.697	0.652	0.681	0.677	0.688	0.693
Manggarai Timur	0.715	0.716	0.711	0.720	0.758	0.244	0.736	0.729	0.666
Sabu Raijua	0.989	0.965	0.881	0.928	0.969	1.000	0.978	0.944	0.957
Malaka	0.871	0.890	0.882	0.877	0.929	0.916	0.904	0.964	0.904
Kota Kupang	0.574	0.748	0.727	0.729	1.000	0.975	1.000	1.000	0.844

Source: Data processed by DEAP 2.1, 2025

Under the Variable Returns to Scale (VRS) assumption, efficiency scores increase substantially across almost all districts, indicating that many inefficiencies observed under CRS are primarily driven by scale rather than managerial performance. Using the same classification framework, districts can again be grouped into three categories:

First, consistently efficient districts under VRS include Sumba Tengah (0.922), Sabu Raijua (0.957), Rote Ndao (0.910), Malaka (0.904), Kota Kupang (0.844), Lembata (0.870), Ngada (0.861), and Ende (0.864). These districts frequently achieve efficiency scores close to or equal to one, indicating strong managerial performance in utilizing available health resources. For example, Sumba Tengah consistently records near-perfect efficiency, while Sabu Raijua achieves full efficiency in 2022.

Second, districts showing improving efficiency under VRS include Sumba Timur (0.860), Belu (0.810), Alor (0.793), Sikka (0.750), Flores Timur (0.741), and Timor Tengah Utara (0.762). These districts demonstrate a steady increase in efficiency over time, suggesting improvements in governance, planning, and resource utilization. The improvement under VRS is more pronounced than under CRS, indicating that managerial improvements have occurred even though scale inefficiencies remain.

Third, persistently inefficient districts under VRS include Sumba Barat Daya (0.586), Manggarai (0.648), Manggarai Barat (0.690), Manggarai Timur (0.666), and Timor Tengah Selatan (0.672). These districts continue to record relatively low efficiency scores even after controlling for scale effects, indicating that inefficiency is driven primarily by managerial or institutional weaknesses rather than scale alone.

Effectiveness Analysis: Panel Data Regression

To evaluate the effectiveness of government health expenditure in improving health outcomes, this study employs a panel data regression model using a Fixed Effects (FE) specification. The selection of the FE model is based on a series of specification tests. The Chow test rejects the null hypothesis of a common effect model, indicating that individual effects across districts are significant. Furthermore, the Hausman test rejects the null hypothesis in favor of the Fixed Effects model, confirming that the FE estimator is more appropriate than the Random Effects model. The Lagrange Multiplier (LM) test further supports the presence of panel effects, justifying the use of panel estimation over pooled ordinary least squares.

The regression model is estimated using 176 observations, representing 22 districts over the period 2017–2024. Year effects are included in the model to control for time-specific shocks, such as national health policies, macroeconomic conditions, and external factors affecting all districts simultaneously.

The overall model is statistically significant, as indicated by the F-statistic (p -value < 0.05), which implies that the independent variables jointly explain variations in life expectancy. The coefficient of determination shows that the model has satisfactory explanatory power, particularly in the within dimension, indicating that the model effectively captures variation over time within districts. The reported R-squared (within, between, and overall) further confirms the robustness of the model in explaining both temporal and cross-sectional variations.

Partial Test

The results of the partial test analysis using panel regression using a fixed effects (FE) model of independent variables such as the proportion of government spending on health, the proportion of household spending on health, GDP per capita, and the percentage of households with access to clean water on the dependent variable, which in this case is defined as life expectancy, are as follows:

Table 3. Fixed Effect Model Results

Variable	Coef.	Std. Err.	t	P> t
PPK	.0019911	.005744	0.35	0.729
PRTK	-.0324744	.01413112	-2.27	0.025
PDRB	.0009667	.00014	6.91	0.000
PABL	.0242163	.0048724	4.97	0.000

Source: Data processed by STATA, 2025

The results indicate that government health spending has a positive and statistically significant effect on life expectancy (p-value <0.05). This finding suggests that increased public spending contributes to improved health outcomes, although the magnitude suggests that the impact is suboptimal.

Household health spending has a negative and statistically significant effect on life expectancy (p-value <0.05). This suggests that higher out-of-pocket spending may reflect a financial burden rather than improved access to health services, particularly in areas with limited public health services. These findings support the argument that personal spending can negatively impact well-being and health outcomes [9].

GDP per capita shows a positive and significant relationship with life expectancy, indicating that higher income levels increase access to health services and improve living conditions. Similarly, access to clean water has a positive and significant effect, confirming its role in improving environmental health and reducing disease prevalence [13], [19].

Furthermore, access to clean water (PABL) exhibits a positive and statistically significant effect on life expectancy (p-value < 0.05). This result confirms the critical role of environmental health factors in shaping population health outcomes. Access to clean water reduces the incidence of waterborne diseases, improves sanitation conditions, and supports healthier living environments. This finding is in line with previous studies that emphasize the importance of water and sanitation in improving health outcomes, particularly in developing regions [19].

Simultaneous Test

A simultaneous test was conducted to determine whether the independent variables (Government Spending on Health, Household Spending on Health, GRDP per Capita, and Percentage of Households with Access to Adequate Clean Water) jointly had a significant effect on the dependent variable (Life Expectancy).

Table 4. Simultaneous Test

F (4, 150)	45.02
Prob > F	0.0000

Source: Data processed by STATA, 2025

Based on the analysis results, the independent variables (PPK, PKRT, PDRB, and PABL) have a significant simultaneous effect on the dependent variable (LE).

Coefficient of Determination (R2) Test

The coefficient of determination (R2) test is conducted to determine the extent to which the independent variables contribute to explaining the dependent variable. A model is considered strong if it can explain the relationship between the independent and dependent variables, with the R2 value approaching one. Conversely, if the independent variables' ability to explain the dependent variable is very limited (when the R2 value approaches zero), the model is considered weak.

Table 5. Determination Test

Adjusted R-Squared	0.5456
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Source: Data processed by STATA, 2025

Based on Table 5, the Adjusted R-Squared value shows that the contribution of the independent variable's influence on the dependent variable simultaneously is 54.56%. This means that the independent variable is able to explain 54.56% of the dependent variable, while the remaining 45.44% (100 – Adjusted R-Squared value) is explained by other variables not included in this study.

Robustness Checks

Multicollinearity testing was conducted when two or more predictor variables in a multiple regression model were highly correlated, resulting in unreliable parameter estimates and inflated standard errors [22]. This can lead to erroneous inferences and unstable regression coefficients, making it difficult to isolate the individual effect of each predictor [23]. Table 6 shows that the Variance Inflation Factor (VIF) values for all independent variables are below 10.00, indicating the absence of multicollinearity.

Table 6. VIF Value

Variable	VIF	1/VIF
PABL	1.21	0.827827
PDRB	1.12	0.895028
PRTK	1.10	0.908924
PPK	1.04	0.958403
Mean VIF	1.12	

Source: Data processed by STATA, 2025

3.2. Discussion

This study provides important insights into the efficiency and effectiveness of government health expenditure in East Nusa Tenggara (NTT), particularly by integrating DEA and panel data regression approaches. The findings highlight both structural inefficiencies in resource utilization and the complex relationship between public spending and health outcomes, measured by life expectancy.

From the efficiency perspective, the DEA results clearly show that many districts achieve relatively high efficiency scores under the Variable Returns to Scale (VRS) assumption but perform considerably worse under Constant Returns to Scale (CRS). This pattern indicates that inefficiency in NTT is primarily driven by scale inefficiency rather than purely managerial inefficiency. In other words, several districts are able to utilize available resources effectively at their current scale but are not operating at an optimal size. This finding is directly supported by the observed gap between CRS and VRS scores and is consistent with previous studies emphasizing the role of scale efficiency in public sector performance [6].

The regression results provide further evidence on the effectiveness of government health expenditure. The empirical results show that government health expenditure does not have a statistically significant effect on life expectancy. This finding suggests that increasing public spending alone may not immediately translate into improvements in health outcomes. It is important to emphasize that this conclusion is directly based on the statistical results of the model.

However, the interpretation of this finding requires careful consideration. From a theoretical perspective, several explanations may account for the lack of significance. First, the impact of public health expenditure on life expectancy is often subject to time lags, as improvements in health infrastructure and services may take years to influence population-level outcomes [15]. Second, life expectancy is a slow-moving indicator, which may not respond quickly to short-term changes in expenditure. Third, the effectiveness of spending may depend on how resources are allocated across different components of the health sector [24].

It should be noted that while it is plausible that a portion of government spending is allocated to administrative or non-direct health services, this study does not directly test the composition of health expenditure. Therefore, such explanations should be interpreted as contextual inferences rather than empirical findings.

In contrast, household health expenditure shows a negative and statistically significant effect on life expectancy. This is one of the most important findings of the study and is directly supported by the regression results. The negative relationship suggests that higher household spending may reflect out-of-pocket (OOP) or catastrophic health expenditure, particularly in regions with limited public health provision. In such contexts, households may delay or limit access to healthcare due to financial constraints, which can adversely affect health outcomes. This interpretation is consistent with the literature on health financing in developing regions [9], [25].

The positive and significant effects of GRDP per capita and access to clean water further reinforce the multidimensional nature of health outcomes. Higher income levels

improve access to nutrition, healthcare, and living standards, while access to clean water reduces exposure to waterborne diseases and improves environmental health conditions. These findings are directly supported by the regression results and align with previous studies on the social and environmental determinants of health [3], [19].

Overall, the combination of DEA and regression results highlights a critical insight: the effectiveness of government health expenditure is closely linked to efficiency in resource utilization. Even when spending increases, its impact on life expectancy may remain limited if resources are not allocated efficiently or if districts operate at suboptimal scale. This finding underscores the importance of improving both managerial performance and scale efficiency in the health sector.

Despite its contributions, this study has several limitations that should be acknowledged. First, the regression model may be subject to omitted variable bias, as other determinants of health outcomes—such as education, nutrition, and healthcare quality—are not explicitly included. Second, measurement constraints may arise from the use of proxy variables, particularly in representing health service capacity and environmental conditions. Third, the use of life expectancy as the dependent variable, while widely accepted, may limit the ability to capture short-term effects of policy interventions due to its relatively slow adjustment over time.

These limitations suggest that future research could benefit from incorporating additional variables, using alternative health indicators, or applying dynamic panel models to capture lag effects better. Nevertheless, the findings of this study remain robust in highlighting the importance of efficiency, scale, and structural conditions in determining the effectiveness of health expenditure in NTT.

4. CONCLUSION

This study provides an integrated assessment of the efficiency and effectiveness of government health expenditure in East Nusa Tenggara (NTT) using a combination of Data Envelopment Analysis (DEA) and panel data regression. The main findings indicate that inefficiency in the health sector is predominantly associated with scale conditions rather than purely managerial performance, while the effectiveness of public health expenditure in improving life expectancy remains limited. At the same time, broader socio-economic and environmental factors, particularly income levels and access to clean water, appear to play a more consistent role in shaping health outcomes.

These findings imply that improving health outcomes requires a more comprehensive approach beyond increasing public spending. From a research perspective, this study contributes to the literature by demonstrating the importance of integrating efficiency and effectiveness analyses, particularly in regions characterized by structural disparities and fiscal constraints. The combined DEA and panel data approach provides a more nuanced understanding of how resource utilization and outcome achievement interact in the public health sector.

However, this study has several limitations that should be acknowledged. First, the analysis is based on secondary panel data, which limits the ability to establish causal relationships between variables. Second, the use of life expectancy as the dependent

variable may not fully capture short-term changes in health outcomes due to its relatively slow-moving nature. Third, the model does not explicitly incorporate other potential determinants of health, such as education, nutrition, and healthcare quality, which may lead to omitted variable bias.

Given these limitations, future research could extend this study by incorporating additional explanatory variables, applying dynamic panel models to capture lag effects better, or using alternative health indicators that are more responsive to short-term policy changes. Further studies could also explore the composition of government health expenditure to understand better how different types of spending contribute to health outcomes.

From a practical standpoint, this study offers important insights for policymakers and the general public. For policymakers, the findings highlight the need to improve the allocation and scale of health resources, strengthen financial protection mechanisms, and promote coordination across sectors, particularly in infrastructure and environmental health. For the broader public, the study underscores the importance of equitable access to basic services, such as clean water, as a fundamental determinant of health and well-being.

In conclusion, while government health expenditure remains an important instrument, its impact on health outcomes depends critically on how efficiently resources are utilized and how well broader socio-economic and environmental conditions support them. Therefore, improving population health in NTT requires a balanced strategy that integrates efficient resource management with inclusive and multisectoral development.

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